CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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CALIFORNIA TROUT.*

By BARTON WARREN EVERMANN and HAROLD C. BRYANT.

INTRODUCTION.

The trout of whatever kind all belong to the Salmonidæ or salmon family. Besides the true trout, this family contains also the salmons, the charrs, the whitefish, the lake herrings, and that curious fish of the far north, the inconnu. The Salmonidæ are confined to the northern hemisphere and chiefly north of the fortieth parallel where they are nearly everywhere abundant wherever suitable waters are found. Some of the species, especially the larger ones, are marine and anadromous, living and growing in the sea, and entering fresh waters only for spawning purposes; still others live in running brooks, entering lakes or the sea as occasion serves, but not habitually doing so; still

*Although containing some new information, this paper is largely a compilation of material from published sources.

others are lake fishes, approaching the shores or entering brooks in the spawning season, at other times retiring to waters of considerable depths. Some species are active, voracious, and gamey, while others are comparatively defenseless and rarely or never take the hook.

Of all the families of fishes there is none more interesting than the Salmonidæ, from whatever point of view they may be considered. To the biologist the family is of surpassing interest because of the remarkable life histories and habits of many of the species; to the angler, what fish has appealed more strongly than salmon and trout because of their game qualities and their beauty? to the epicure, there is none more delicious or more persistently sought; to the lover of the beautiful as exhibited in animate forms, what appeals more strongly than the silvery sheen, roseate or golden hues, and the beautiful form of the salmon, the brook trout or the golden trout; to the fish culturist, the Salmonidæ are of the greatest interest and importance, more species of this family being propagated artificially than of all other species combined; and to the commercial fisherman, this family of fishes is the most important in all the world.

The true trout all belong to the genus *Salmo* and are found only in the northern parts of Asia, Europe and North America; in Europe they extend as far south as the Pyrenees, and in America to Lower California and Durango and eastward as far as the Black Hills and Colorado.

The name "trout," a word of French origin, is in Europe applied only to species with black spots, while in America it is more loosely used and is applied not only to the true trout (those with black spots), but also to the charrs (or those with red or orange spots). In western North America are many species of true trout, some of them differing widely in size and color, while others resemble each other so closely as to make positive identification difficult. The Salmonidæ are of comparatively recent origin, none of the species occurring as fossils except in recent deposits, and this doubtless accounts for the instability of their specific characters.

How to Distinguish Trout from Salmon.

Trout.	Salmon.
1. Most species remain in fresh water, never going to sea; do not die after once spawning.	1. Live habitually in the sea, entering fresh water only at spawning time; spawn once then die.
2. Skeleton hard.	2. Skeleton porous and soft.
3. Anal fin with 12 or fewer rays.	3. Anal fin with 13 to 20 rays.
4. Gillrakers, 20 or fewer.	4. Gillrakers, 20 to 40.
5. Pyloric cæca few, 40 to 65.	5. Pyloric cæca numerous, 75 to 180.
6. Branchiostegals, 10 to 12.	6. Branchiostegals, 13 to 19
7. Caudal peduncle deep.	7. Caudal peduncle constricted.

The commercial fisherman distinguishes between salmon and trout by noting whether the fish is easily held up by the tail. The constricted portion in front of the tail (caudal peduncle) makes it easy to hold a salmon by the tail, but that of a trout is so nearly the size of the tail fin that it is held up with difficulty.

The native trout of western North America may be regarded as falling naturally into three more or less well-defined series, which are popularly

known as the Cutthroat Series, the Steelhead Series, and the Rainbow Series.

The species of the Cutthroat Series are characterized by small scales, 150 to 200 in a cross-series, a large deep-red or scarlet dash on each side of the throat, a large mouth, the maxillary more than half length of head, and small hyoid teeth. The most useful diagnostic character is the red dash or mark on each side of the throat between the dentary bones of the lower jaw. This mark is nearly always present and is usually quite distinct.

There are many species of the Cutthroat Series. They inhabit the streams and lakes from Humboldt County, California, northward to southeast Alaska and eastward through all of the northwestern states to the headwaters of the Missouri, the Platte, the Arkansas and the Rio Grande. At least one species is found in the headwaters of the Colorado. They are particularly abundant in the coastal streams and lakes of Oregon and Washington. In California, they appear to be confined chiefly to the northwest counties and are nowhere abundant.

In the Steelhead Series the scales are somewhat larger, the number in a cross-series being usually about 150, but varying from 130 to 180. There is no red dash on the lower jaw; the body is rather stout, mouth moderate, the maxillary about half length of head, hyoid teeth wanting. Color silvery. Size large. Sea-run species.

In California, the steelhead is limited to coastwise streams and is anadromous. To the northward, it extends further inland, ascending the Columbia and its tributaries to Shoshone Falls in Snake River and to the headwaters of Salmon River in Idaho. To the northward it is found as far as Kodiak Island. In certain lakes of Washington and British Columbia are found several local forms which have been described as distinct species.

In the Rainbow Series the scales are typically still larger (except in the golden trouts), the number in a cross-series being normally 130, but varying from 115 to 180; usually no red on the throat; a red or rosy lateral band; body stout; mouth small, the maxillary short, 2 to 2.5 in head; no hyoid teeth. Size small.

The rainbow forms are chiefly confined to the streams of California and Oregon. The typical rainbow (*Salmo irideus*) was originally described by Dr. William P. Gibbons of San Francisco in the Proceedings of the California Academy of Sciences for 1855, from specimens obtained in San Leandro Creek, Alameda County. The rainbow occurs less abundantly in Oregon and Washington and as far north as Naha Stream and Klawak River, Alaska.

Besides these three series of true trouts, we have the charrs of the genera *Salvelinus* and *Cristivomer*. The "Dolly Varden" is the only native charr in California. The introduced Eastern brook trout is a near relative, and is, like it, a charr. The charrs are separated from the true trout by the presence of red or orange-colored spots on the sides. The word "charr" means "red" or "blood," and since members of the genus *Salvelinus* are usually marked with red spots or are red beneath, the group is well named.

In addition to the native trout, there are several species which have been introduced into California streams from Europe. Chief among these are the brown trout from central Europe and the Loch Leven trout from Scotland.

Cutthroat Series.

The native lake trout in the larger lakes of the Sierras and one of the stream trouts of northern and northwestern California are cutthroats. The species now recognized are:

Cutthroat Trout (*Salmo clarkii*), in Pit River, Eel River and other streams in Humboldt and Del Norte counties.

Tahoe Trout (*Salmo henshawi*), in Lake Tahoe, Donner, Webber, and Independence lakes and tributary streams. Included under this name are several trout which have been described as distinct species.

Royal Silver Trout (*Salmo regalis*), in Lake Tahoe.

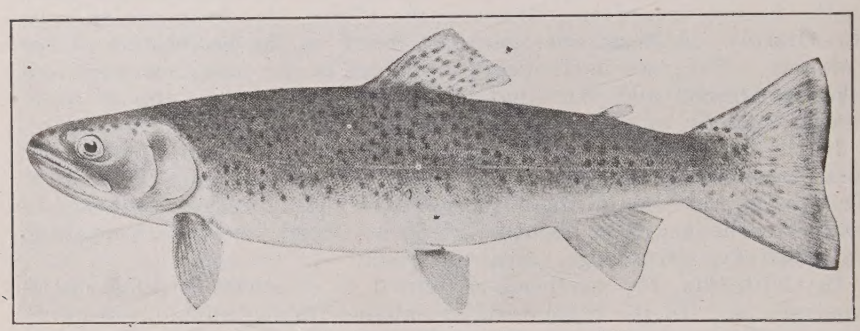

Fig. 36. Cutthroat trout (*Salmo clarkii*).

Charrs.

The Dolly Varden (*Salvelinus parkei*) is the only charr native to California streams. Its distribution in this state is limited to the McCloud River. The introduced Eastern brook trout (*Salvelinus fontinalis*) and the Mackinaw Trout (*Cristivomer namaycush*) are the only other charrs found here.

Rainbow Series.

Most of the native trout found in California belong to this series. The following eight species are here recognized as belonging to the Rainbow Series.

Shasta Rainbow (*Salmo shasta*), in the upper Sacramento and McCloud rivers.

Noshee or **Stone Trout** (*Salmo stonei*), in the McCloud River.

Gilbert Rainbow (*Salmo gilberti*), in the Kings and Kern rivers.

South Fork of Kern Golden Trout (*Salmo agua-bonita*), native only to the South Fork of the Kern, and from Cottonwood Creek and the Cottonwood Lakes into which it has been introduced.

Golden Trout or **Roosevelt Trout** (*Salmo roosevelti*), native only to Volcano Creek.

Soda Creek or **Little Kern Trout** (*Salmo whitei*), native to the Little Kern and other western tributaries of Kern River.

San Gorgonio Trout (*Salmo evermanni*), known only from the streams about San Gorgonio Peak, southern California.

Nelson Trout (*Salmo nelsoni*), known only from the San Pedro Martir Mountains of Lower California.

There is a trout, apparently of the Rainbow Series, in the Klamath River which fish culturists believe to be different from any of the above, which has not yet been described. There is still another in Burney Creek, Shasta County, which also remains to be described.

Introduced Trout.

As a result of hatchery operations the following non-native trouts are to be found in California streams:

Brown Trout (*Salmo fario*), a native of central Europe.

Loch Leven Trout (*Salmo trutta levenensis*), a native of Scotland.

Eastern Brook Trout (*Salvelinus fontinalis*), a native of the Atlantic Coast streams.

Mackinaw Trout (*Cristovomer namaycush*), a native of the larger lakes of the northeastern United States and Canada.

Size and Coloration.

Size seems to depend upon food supply and extent of water. Residents of small mountain streams and pools seldom attain the size of individuals inhabiting lakes or rivers where there is an abundant food supply.

Water appears to have some influence on the coloration of trout. Brackish or salt water usually gives them a silvery color with few or no spots. Possibly the substrata constitute the factor most involved in coloration. Profusely spotted trout are generally found in clear rapid rivers or alpine pools; in large lakes with a peaty bottom, fish often assume an almost uniform blackish coloration.

Sexual differences are not always apparent in trout except in the breeding season, at which time the female is usually a deeper, heavier fish and the male a more slender one. However, the male is sometimes the brighter in color.

Young trout are all similarly barred with the parr-marks and are difficult to identify.

Trout Angling.

The usual style of fly fishing consists in wading the stream and making casts downstream in likely places—at the foot of riffles, at the edges of stumps, logs and brush, and beneath overhanging bushes and banks. On the contrary, the more refined, dry-fly angler casts upstream, presenting his fly in such a manner that it will float over a rising fish. In order to have the flies float, they must be dry. They are oiled before using, and false casts are made between real casts to remove the surplus moisture.

Some fishermen drag the flies over the water at the end of each cast, believing that the motion resembles that of an insect endeavoring

to escape from the water. Sometimes flies are tied with head toward the hook-barb so that, on being drawn over the water, the resistance of their legs and wings will cause them to flutter as if alive.

The dry-fly angler declares that the more attractive method is to allow the flies to float quietly, and to enable them to remain on the surface. Usually local dealers can supply the best information on the proper flies to use.

When streams are high, better results are obtained by the use of baits such as prepared salmon eggs or grasshoppers, earthworms and helgramites. In clearer water spinners may also be used with good effect.

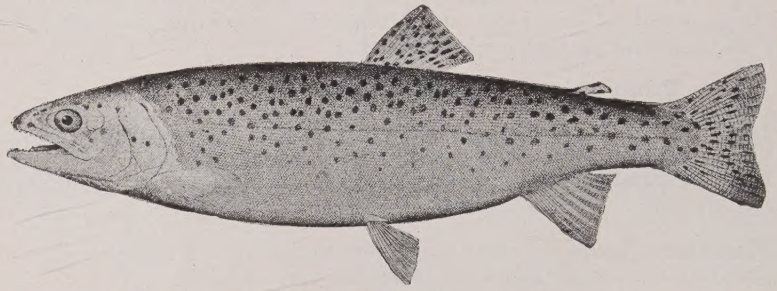

Fig. 37. Tahoe trout (*Salmo henshawi*).

Trolling is the method usually employed by fishermen and anglers in catching trout in the larger lakes. Similar equipment is used by anglers in taking the so-called steelhead at river mouths. But these methods are not practiced by the accomplished angler.

"Along the lower courses of the rivers and on the lakes, especially off rocky points where the rapidly shelving bottom brings the deep water near shore, a crude method of bait casting is successfully employed in taking large trout. The large trout seldom rise to the artificial fly except at times in the high Sierras. The same species when living in the rivers and in their rapid and cool tributaries furnish excellent sport for the angler. All recommend small flies, 12 to 16, and not in great variety. Many of the smaller streams are so closely lined with dense brush as to make fly fishing quite out of the question. Here the angler should provide himself with a short bait rod, use worms and grasshoppers."—*Snyder.*

As has been pointed out in many an article, the prime rules of fly fishing are:

1. Fish in streams where trout are found. Those streams not easily accessible are always best, for they are not depleted.
2. Move cautiously and noiselessly in order not to frighten the fish.
3. Drop the fly on the water "as if it hated to get wet" or, in other words, simulate the natural dropping of an insect on the water.

KEY TO CALIFORNIA SPECIES OF TROUT.

a. Species anadromous, entering coastal streams for spawning purposes; color silvery;

aa. Species not anadromous; size smaller.
size large—**Steelhead** (Salmo gairdneri). Page 112

b. Scales typically large (except in the Golden trouts), about 130 in a cross-series (varying from 120 to 180); little or no red on throat; usually a rosy or yellowish lateral band; mouth small, maxillary 2 to 2.5 in head; no hyoid teeth; size small.

c. No extensive lemon yellow on sides below lateral line.

d. Body elongate; color rosy or silvery, especially on side; spots small—**Rainbow Trout** (Salmo irideus). Page 112

dd. Body rather deep.

e. A reddish lateral band.

f. Black spots largely restricted to the back, few below median line.

g. Vomerine teeth in a single zig-zag series—**McCloud River Trout** (Salmo shasta). Page 115

gg. Vomerine teeth in two irregular series—**Noshee Trout** (Salmo stonei). Page 116

ff. Entire body and all fins profusely black-spotted—**Kern River Trout** (Salmo gilberti). Page 118

fff. Heavily and uniformly spotted; fawn brown on sides—San Gorgonio Trout (Salmo evermanni). Page 117

ee. A greenish lateral band—**Eagle Lake Trout** (Salmo aquilarum). Page 116

cc. Extensive lemon yellow or orange on sides and belly.

h. Back and upper two-thirds of sides covered rather closely with small black spots; lower third of side, except on caudal peduncle, without spots—**Golden Trout of the Little Kern, or Soda Creek Trout** (Salmo whitei). Page 121

hh. Back and upper one-third of side sparsely black spotted; lower two-thirds of side, except on caudal peduncle, entirely without spots—**Golden Trout South Fork of Kern** (Salmo agua-bonita). Page 123

hhh. Back, head, and entire side, except on caudal peduncle, entirely without spots; a few spots on the caudal peduncle—**Roosevelt Trout** (Salmo roosevelti). Page 124

bb. Scales small, usually about 150-200 in crosswise series; red marks under dentary bones always present; mouth large, the maxillary 1.6 to 2.25 in head; hyoid teeth present; irregularly and profusely scattered.

i. Black spots encroaching somewhat on belly—**Cutthroat Trout** (Salmo clarkii). Page 127

ii. Black spots sparsely scattered—**Tahoe Trout** (Salmo henshawi). Page 127

iii. No black spots; back bluish or greenish—**Royal Silver Trout** (Salmo regalis). Page 129

bbb. Scales so small as to be almost invisible, 200-250 in lateral series; no red on throat.

j. Sides with red spots.

k. Back unspotted, strongly marbled with dark olive or black—**Eastern Brook Trout** (Salvelinus fontinalis). Page 130

kk. Back not marbled with olive or black; but spotted with red or orange—**Dolly Varden Trout** (Salvelinus parkei). Page 129

jj. Back and sides with gray spots—**Mackinaw Trout** (Cristivomer namaycush). Page 133

bbbb. Scales very large, 118-130 in lateral series; introduced species.

l. Adipose fin large, its width much more than half its length—**Brown Trout** (Salmo fario). Page 131

ll. Adipose fin small, its width one-half its length—**Loch Leven Trout** (Salmo trutta levenensis). Page 132

NATIVE SPECIES.

Steelhead Series.

STEELHEAD.

Salmo gairdneri Richardson.

Other names: Steelhead Trout; Steelhead Salmon; Salmon Trout; Hardhead.

Description: Head in length to base of tail fin 4.5 to 5; depth 4.5; eye 4.5 in head; dorsal 11; anal 11 or 12; branchiostegals 11 or 12; scales usually about 30-150-28, the cross-series varying from 130 to 180; pyloric cæca 42; gill-rakers, 8+12; vertebræ 38+20. Body rather stout, the caudal peduncle thick; head rather short and slender, only about twice length of maxillary; eye small; teeth small, those on vomer in two long, alternating series which are about as long as the palatine series; no hyoid teeth. Tail wide, squarely truncate in the adult, emarginate in the young. Color olive-green above, silvery on sides and belly; head, back, and dorsal and caudal fins more or less closely covered with small black spots. During the breeding season, side with a broad rosy or flesh-colored lateral band, deep rosy on the cheek, this often remaining through the year; fins not red; no red on lower jaw.

Marks for field identification: Large size; small head; large scales; bright silvery color; absence of red on lower jaw.

Distribution in California: The steelhead enters coastwise streams from Ventura River northward, ascending to their headwaters for spawning purposes and then returning to the sea.

The steelhead is more or less anadromous in its habits, it being migratory like the salmon, spending much of its time in salt water, and ascending freshwater streams at spawning time. It enters practically all the coastal streams of California from Ventura County on the south to the Oregon line; also from there to Skagway and Sitka. Many of the streams on the California coast are famous for their steelhead; special mention may be made of Ventura River, the Santa Ynez, Santa Maria, those entering Monterey Bay, and all the streams north of San Francisco, particularly the Russian, the Klamath, and the Eel.

As a game fish the steelhead is a favorite with the anglers. Its game qualities, together with its large size, make this one of the fishes most sought after by the followers of good old Isaak Walton. When in fresh water it will not only take the trolling spoon, but it will rise readily to the fly.

The steelhead is an excellent food fish, and its large size and abundance make it a fish of considerable commercial value. It is an important fish in the fish cultural operations of California and of other Pacific Coast states and the federal government. It has been introduced into Lake Superior and is now an abundant and much prized game fish in that lake and its tributary streams.

The fact that most ichthyologists and many anglers regard steelheads simply as sea-run individuals of rainbow trout has not escaped our minds, and we ourselves are inclined to accept that view. Nevertheless we know that in some places, they are entirely distinct and easily distinguishable. At any rate, we deem it best for our present purposes to treat the steelhead as a distinct species.

RAINBOW TROUT.

Salmo irideus Gibbons.

Other names: Mountain Trout; Speckled Trout; Brook Trout; California Trout. Sea-run form: Steelhead; Steelhead Salmon; Salmon Trout; *Salmo rivularis*, in part; *Salmo gairdneri*, in part.

—*From drawing by Charles Bradford Hudson*

STEELHEAD TROUT (*Salmo irideus, a sea-run form*)

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Description: Head 3.8; depth about 4; eye 4.83 in head, 1.4 in snout; snout 3.6; D. 10; A. 11; scales 24-130-20, about 70 series in front of dorsal, counting along median line, or 60 if rows along upper side are counted; branchiostegals 11; gillrakers 8+13, rather long and slender. Head pointed, mouth, rather large, maxillary extending to posterior margin of eye, 1.8 in head, with about 20 teeth; preorbital very narrow, the maxillary almost touching the orbit; several large teeth along side of tongue; no hyoid teeth; teeth on vomer in zig-zag series; origin of dorsal at middle of length; origin of anal midway between that of dorsal and base of caudal; caudal broad, nearly truncate. Color, on the back a deep dark-blue ultramarine of a peculiar transparency, dotted with small round black spots about the size of a pin head; side abruptly brighter, with many scales silvery; lower parts white; sides, top of head, dorsal, and caudal fins covered with very small spots; pectorals and ventrals nearly colorless, without spots; adipose fin with two spots; no red on lower jaw.

Marks for field identification: Rainbow trout usually have a great many spots, which are more or less obscured by a silvery sheen in the sea-run examples. Average specimens are from 4 to 12 inches in length and weigh as much as 6 or 7 pounds, but average 3 or 4. Sea-run examples sometimes weigh 25 pounds. From the cutthroat trout the rainbow may be known by its larger scales, brighter coloration, and by the absence of red on the throat. The comparatively large scales (120-150) distinguish the true rainbow from the species found in the McCloud and Kern rivers.

Distribution: Native in all coastal streams and most streams of the interior, especially those of the western slope of the Sierras. Introduced in many lakes and streams of the state formerly barren of fish life.

The rainbow runs upstream in early spring to spawn, leaping over waterfalls and entering the small streams forming the headwaters. Here the eggs are deposited in the sand and the young are hatched out.

Fig. 38. Young steelhead trout. All young trout have black bars on the sides, which are known as parr marks.

By far the largest output of the state hatcheries is composed of rainbow trout, and there is good reason, for this is considered the best game fish of all and it is most highly prized by anglers. The rainbow often leaves the water in its eagerness to take a fly. In fact, so readily does it take a fly that there is seldom need to resort to bait or other lures.

This trout has thriven almost everywhere, having been introduced into New Zealand, Japan, Europe, and the eastern United States.

The rainbow varies in coloring according to age, sex, and location. Those individuals which are able to reach the sea spend part of each year there, returning to the freshwater stream a larger and more silvery-colored fish commonly called steelhead. Spawning fish travel far up the coastal streams and spawn high up in the small tributaries. Their habits in this regard are more like those of the salmon than those

of a trout. Unlike the salmon, however, the steelhead does not as a rule die after once spawning.

Specimens returning from the sea are usually silvery in color, but spotting soon appears in the freshwater stream. Because of its large size and excellent flavor the sea-run form is a splendid food fish. It is marketed in large quantities during the open season; as a game fish prized by anglers who troll in the bays and river mouths along the northern coast.

"In beauty of color, gracefulness of form and movement, sprightliness when in the water, reckless dash with which it springs from the water to meet the descending fly ere it strikes the surface, and the mad and repeated leaps from the water when hooked, the rainbow trout must ever hold a very high rank. The gamest fish we have ever seen was a 16-inch rainbow taken on a fly in a small spring branch tributary of Williamson River in southern Oregon. It was in a broad and deep pool of exceedingly clear water. As the angler from behind a clump of willows made the cast the trout bounded from the water and met the fly in the air a foot or more above the surface; missing it he dropped upon the water only to turn about and strike viciously a second time at the fly just as it touched the surface; though he again missed the fly the hook caught him in the lower jaw from the outside, and then began a fight which would delight the heart of any angler. His first effort was to reach the bottom of the pool, then, doubling upon the line, he made three jumps from the water in quick succession, clearing the surface in each instance from 1 to 4 feet, and every time doing his utmost to free himself from the hook by shaking his head as vigorously as a dog shakes a rat. Then he would rush wildly about in the large pool, now attempting to go down over the riffle below the pool, now trying the opposite direction, and often striving to hide under one or

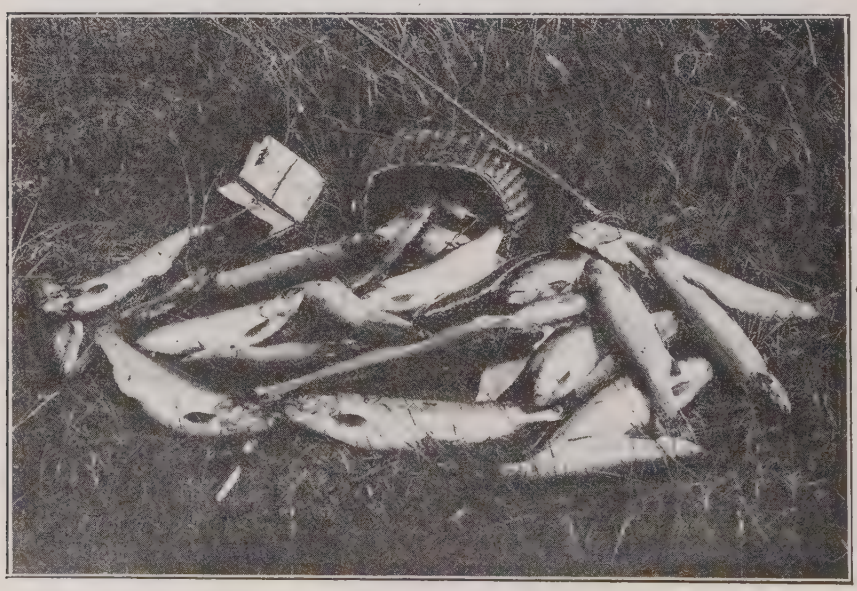

Fig. 39. Rainbow trout taken in Manzanita Lake, near Red Bluff, Tehama County, California.

—*From drawing by Charles Bradford Hudson*

RAINBOW TROUT (*Salmo irideus, a stream form*)

the other of the banks. It was easy to handle the fish when the dash was made up or down stream or for the opposite side, but when he turned about and made a rush for the protection of the overhanging bank upon which the angler stood, it was not easy to keep the line taut. Movements such as these were frequently repeated and two more leaps were made. But finally he was worn out after as honest a fight as trout ever made.

"The rainbow takes the fly so readily that there is no reason for resorting to grasshoppers, salmon eggs, or other bait. It is a fish whose gameness will satisfy the most exacting of expert anglers and whose readiness to take any proper lure will please the most impatient of amateurs." (Evermann.)

Spawning takes place in winter and early spring, varying with temperature and locality. The bulk of the eggs are usually taken in February, March, and April, although spawning continues through May in the mountain districts. The average yield from each female is about 900 eggs. A few of the females spawn when three years old, but about one-half of them begin at four years. The egg is from one-fifth to two-ninths of an inch in diameter; it has a pink color when first taken, becoming darker before hatching. The rainbow feeds on worms, insect larvæ, and salmon eggs. In streams in which the salmon and rainbow exist together, the rainbow is more destructive to the salmon eggs than any other species except the Dolly Varden.

McCLOUD RIVER TROUT.

Salmo shasta Jordan.

Other names: Shasta Trout; Shasta Rainbow. *Salmo gairdneri shasta; Salmo irideus shasta.*

Description: Head 4; depth 3.8; eye 5; D. 11; A. 11; scales 20 to 24-145-20, about 65 before the dorsal. Body comparatively short and deep, compressed, varying considerably, and much more elongate in males than in females; head short, convex, obtusely ridged above; mouth smaller than in most species of trout, the rather broad maxillary scarcely reaching beyond the eye, except in old males; eye large, about one-fifth length of head; vomerine teeth in two irregular series; dorsal fin moderate; caudal fin distinctly though not strongly forked, more deeply incised than in the typical cutthroat. Color, bluish above, the sides silvery; everywhere above profusely but irregularly spotted, the spots extending on the sides at least to the lateral line, and covering the vertical fins; top of head well spotted; fins usually not red; much red or rosy on cheeks and opercles; belly partly red in males; side with a broad but more or less interrupted red lateral band, brightest in males. (Jordan and Evermann.)

Marks for field identification: Differs from other rainbow trout, with the exception of that in the Klamath River, in its larger size, smaller mouth and larger eyes. Scales are intermediate in size between cutthroat and sea-run rainbow (steelhead), about 145 in transverse series. Caudal fin more deeply incised than in typical cutthroat.

Distribution: McCloud River and streams of the Sierras from Mount Shasta southward at least to Calaveras County.

This rainbow lives in water with a comparatively high temperature if it is plentiful and running with a strong current; but in sluggish water, even when the temperature is considerably lower, no species will do well. This species appears to inhabit the rapids more largely than the slow-moving water. The spawning season in California extends from early February to May. Males are good breeders at two years old, but the females rarely produce eggs until the third season. It may lack a little in the wild gaminess of the typical rainbow, but that is

made good by its larger size. It is largely an insect feeder and, therefore, a favorite of the fly fisherman.

This is the rainbow which has been most widely used in fish cultural operations and has been more widely distributed than any other variety.

NOSHEE TROUT.

Salmo stonei Jordan.

Other names: Nissuee Trout; Stone's Trout; Nissui Trout; *Salmo irideus stonei.*

Description: Depth 4; A. 11; eye 4.5; maxillary about 2; pectoral 1.3; scales 140 to 155, about 82 before the dorsal, where they are small and embedded; teeth fewer and smaller than in the Shasta trout, those on the vomer in a single zig-zag series. Color, upper parts plain greenish; spots few and confined chiefly to the posterior part of body; spots small and sparse on dorsal, adipose and caudal fins; a red lateral band usually distinct; cheeks and opercles with red; no red on throat. (Jordan and Evermann)

Marks for field identification: Much larger than typical rainbow, reaching a weight of 10 to 12 pounds; teeth are fewer and smaller than those of typical rainbow.

Distribution: Upper Sacramento Basin, especially in the McCloud River above Baird.

Voracious. Little is known about this trout.

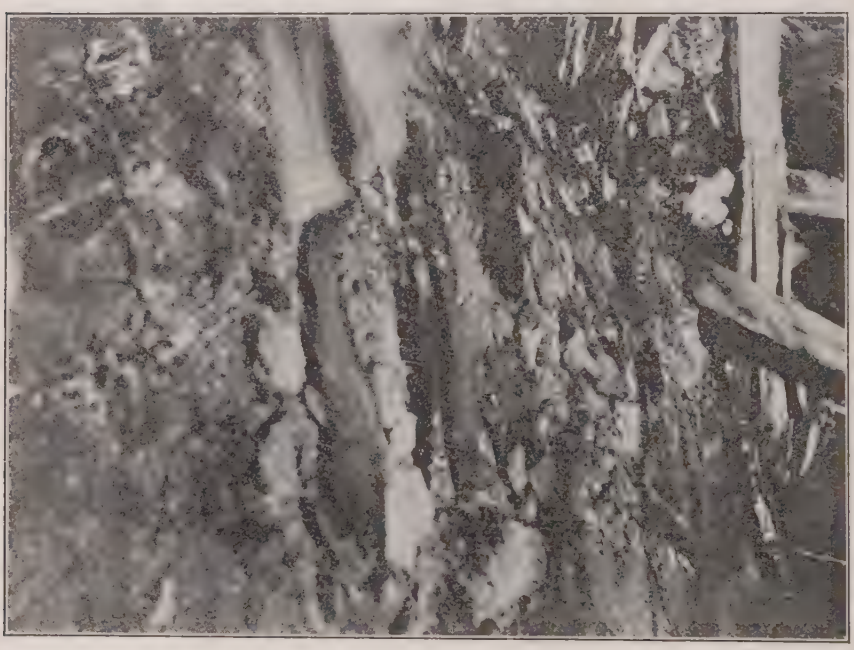

Fig. 40. Trout spawning. The female can be seen at the left digging up the sand preparatory to depositing eggs. The male is shown at the right. Photograph by J. H. Gyger, taken on Orchard Creek, San Bernardino Mountains, April 25, 1916.

EAGLE LAKE TROUT.

Salmo aquilarum Snyder.

Other names: *Salmo clarkii,* in part.

Description: Head 4.2 in length to base of caudal; depth 4.2; depth of caudal peduncle 9.8; eye 7.5 in head; interorbital space 3; snout 3.5; maxillary 1.9; height of dorsal 6.5 in length; adipose fin 12.5; length of caudal 4.8; pectoral 5.6;

ventral 7.5; height of anal 6.9; scales in lateral series 136. Body deep; caudal peduncle robust; head rather pointed; maxillary broad and long, extending far beyond posterior border of eye; edge of opercle 3.8 in head. Branchiostegals 11. Gillrakers 18, rather thick at base, pointed at tips, and decidedly sickle-shaped. Vomerine teeth in three series in front, the middle ones extending backward; teeth of palatines, maxillaries, and mandibles in a single series; glossohyal with teeth; basi-branchials without teeth. Scales large and deeply embedded; pores in lateral line 120; series of scales above lateral line, counting upward and forward to a point just before dorsal, 29. Scales of nape minute and closely crowded as are those of throat and abdomen. Axillary scales of ventral small, equal in length to vertical diameter of eye, sharply pointed. Dorsal rays 11, edge of fine concave; adipose dorsal very large, broad and thick; caudal broad and strong, the posterior edge slightly concave, the lower lobe a little longer than the upper; anal ray 11, edge of fin somewhat concave; pectorals strong and rather pointed; ventrals obtusely pointed.

Marks for field identification: Distinguished from other trouts of the Sierras by the robust body with a deep caudal peduncle and large and strong fins, conspicuous adipose fin, large scales, and the red color of cheeks and coppery red of under parts. The flesh is deep red, very firm and fatty, far superior to that of the Tahoe Trout.

Distribution: Eagle Lake and its tributary, Pine Creek.

The annual spawning migration occurs in May, when apparently the entire trout population of the lake attempts to move up Pine Creek. It is said that anglers do not succeed in catching trout in Eagle Lake, their failure being attributed to either a scarcity of fish or an abundance of food. (Snyder.)

Fig. 41. San Gorgonio trout (*Salmo evermanni*). Found only in the upper Santa Ana River, Mount San Gorgonio, southern California.

SAN GORGONIO TROUT.

Salmo evermanni Jordan & Grinnell.

Other names: Evermann Trout: San Bernardino Rainbow Trout.

Description: Length of type, an adult male (as measured when first caught), 11.63 inches; head measured along side 2.75 inches. Head 3.63 in length to base of caudal, the jaws being somewhat produced; depth of body 4.7; eye 6.5 in head; maxillary 1.75 in head; dorsal with 10 rays, anal with 10; 34 scales between base of dorsal and lateral line, 167 oblique rows crossing lateral line, and 33 scales between lateral line and vent. Snout (from eye) 3.3 in head; anal 2 in head; ventral 2.2 in head; pectoral 1.37 in head; dorsal 1.57 in head. Caudal distinctly emarginate, or lunate. Vomerine teeth in two straight rows; hyoid teeth present, though buried in mucus; Maxillary extending well beyond eye, so that the mouth is relatively large. In the female, the head is shorter and the maxillary 1.8 in head. Coloration, very dark fawn-brown, the spots unusually large and covering the whole length of the body, none of the brilliant hues of *Salmo agua-bonita, roosevelti* or *whitei*, nor even the crimson of *irideus*. Ground fawn-color along sides; varying toward seal brown dorsally; a large patch of same color on cheek; lower parts lighter (fresh tints unknown, but no red in throat region shown in the specimens); black spotting conspicuous, the spots evenly distributed, very large, on sides posteriorly the size of pupil

or larger, smaller on top of head; 25 on dorsal fin, mostly in four rows; caudal fin nearly as distinctly spotted as sides, with spots more closely set. Younger individuals are somewhat lighter, but yet considerably darker than *irideus* of the same size, and the other characteristics seem to be constant.

Marks for field identification: Differs from the rainbow in small size and slightly different coloration. As compared with *Salmo irideus*, *Salmo evermanni* is slenderer, especially dorso-ventrally; the head is longer, the snout sharper, and mouth larger; the scales are very much smaller and more numerous, not overlapping; the colors are dull and very dark, and the spotting is heavy.

Distribution: Upper Santa Ana River in the San Bernardino Mountains of southern California.

Habits similar to other rainbows. It is probable that the San Bernardino trout is the older species in the region where found, and owes its preservation as a distinct species, and perhaps the accentuation of its characters, to isolation afforded by the barrier which prevents the invasion of the rainbow trout from the lower stream. In the remote history of the stream, the falls have doubtless shifted and become more effective, so that the ancestral stock of San Gorgonio trout was originally able to ascend to its present remote and limited habitat. (Jordan and Grinnell.)

Fig. 42. Eagle Lake trout (*Salmo aquilarum*). Found only in Eagle Lake and tributary streams.

KERN RIVER TROUT.

Salmo gilberti Jordan.

Other names: Gilbert Trout; Kern River Rainbow Trout; *Salmo irideus gilberti.*

Description: Head 4 in length to base of caudal; depth 3.6; eye 5 in head; snout 4.3; maxillary 1.6; mandible 1.3; preorbital 20; scales small, about 165 in lateral line; dorsal fin with 14 rays; anal 12. Body stout, moderately compressed, deepest slightly in front of dorsal; head long, conic, snout pointed; mouth large, maxillary long and narrow, reaching more than an eye's diameter beyond the eye; mandible slightly curved; teeth on lower jaw rather strong, wide-set, in a single series, those on maxillary strongest; caudal peduncle stout, its least depth equal to snout and eye. Fins all well developed; origin of dorsal midway between tip of snout and base of tail, the longest ray nearly two in head, base of fin slightly greater than height; caudal broad, truncate, the lobes equal, exceeding height of dorsal; base of anal equaling height of dorsal; origin of ventrals somewhat posterior to that of dorsal and much nearer base of caudal than tip of snout, longest ventral ray equal to longest dorsal ray; longest pectoral ray exceeding by one-fourth the height of dorsal.

Color in life, head, body, and fins everywhere profusely and rather uniformly covered with small black spots, those on body stellate, those on fins oblong, those on head roundish and more sparse; inner half of ventrals with the anterior rays white at tip; adipose dorsal olivaceous with three or four black spots; side broadly rich rosy red, broadest and brightest near middle, least distinct on caudal peduncle; lower half of side slightly pink and pale bluish; belly with

slight irregular wash of old gold on dirty-white ground color; back and upper part of side olivaceous with fine yellow, orange, or lemon specks; cheeks and opercles rich rosy; little or no red on throat, no dash on membrane between rami of lower jaw; few spots on side of head; top of head olive green, well covered with round black spots.

This description is from an example (male) 18.25 inches long, weighing 3.5 pounds, taken by the senior author July 19, 1904, in Kern River about one-half mile above Kern Lake.

Marks for field identification: Profusely and closely spotted over the entire body, head, and on all the fins, the belly not so richly colored. It is similar to the McCloud River trout, but has smaller scales, about 165 in a transverse series. There is usually a distinct whitish tipping to the dorsal, ventral and anal fins.

Distribution: Kern, and probably Kings, Merced and other rivers of the southern Sierras. This species is abundant in Kern Lake and in the river for some miles below the lake, but of this we have no personal knowledge, as no collecting has been done below the lake. As a rule, the fish taken from the river are more deeply and brightly colored and decidedly more gamey than those from the lake. During the spawning season early in the spring the fish are found chiefly in the river, but after the spawning has been completed they tend to run down into the lake, where they become less active and less highly colored. Large examples from the lake are, as a rule, more slender than those from the river, probably on account of the fact that those from the lake are all spent fish.

The Kern River trout is a beautiful fish, well built and symmetrical, and very rich in coloration when in prime condition. As a game fish it will stand easily among the best, but, as already stated, in the river it greatly excels those of its kind in the lake. It usually takes the fly quite freely, and will, of course, take all sorts of live or cut bait. We have taken these trout "with the artificial fly, with grasshoppers (which they greatly preferred), and with pieces of fish or other meat. The large example from which the colored plate was made was first tried with a gray hackle, to which he rose once and then paid no more attention to it. A larger, plain hook and a good-sized grasshopper were substituted, with better results. Scarcely had the lure touched the water when he rose and struck most viciously, only to miss it, then turn and strike more viciously than before. This time the hook caught inside the mouth just under the middle of maxillary, and then began a fight that would delight a better angler than I. He first circled about in a wide curve, then jumped twice, clearing the water beautifully each time; circled again, went to the bottom in water ten feet deep, came to the surface and jumped again, after which no more leaps were made, but he continued dashing about until finally brought to net." (Evermann.)

THE GOLDEN TROUT OF CALIFORNIA.

The golden trout of California are, so far as known, found only in the headwaters of the Kern River, all in the vicinity of Mount Whitney. To be sure, through the activities of the California Fish and Game Commission and other agencies, their original distribution has been somewhat extended by transplanting.

Four species of trout are now recognized as native to the upper Kern River basin, namely: the Kern River trout or Gilbert trout (*Salmo gilberti*), the Soda Creek or White's golden trout (*Salmo whitei*), the South Fork of Kern golden trout (*Salmo agua-bonita*), and the Roosevelt trout or golden trout of Volcano Creek (*Salmo roosevelti*). All except the Gilbert trout are of the golden trout type.

All four of these species belong to the Rainbow Series, the species of which as a whole may be distinguished, with greater or less difficulty, from those of the Steelhead Series or sea-run rainbows on the one hand by the usually brighter colors, and on the other hand, from the Cutthroat Series by the absence of a red or scarlet dash on the throat and the entire absence of hyoid teeth.

The three species of golden trout differ as a group from the other recognized species of the Rainbow Series in having decidedly smaller scales and a very brilliant coloration.

When the first trout came to the beautiful streams of the southern High Sierra no one certainly knows; but it must have been long, long ago, as men count time, when melting ice filled the Valley of Death and the terrible deserts of Panamint and Amargosa with sweet waters. Long before that time trout had found their way into the Rio Colorado and when the ice came it was not hard for them to push westward to certain headwaters of the San Joaquin. Among the first to come were some that took up their home in the Great Kern, a wild, strange river, whose sources are among the highest of California's great mountains and whose course for many miles is almost meridional by the compass through a great canyon hundreds of feet deep and marvelous in its stupendous grandeur and beauty. In this river the trout were free to roam about as they liked. Sometimes they would go far down the stream and even out into that wonderful Tulare Lake, then much larger and much colder than it has ever been since. Then in early spring they would go the other way, even entering the tributary streams and penetrating to the little rivulets that trickle from the flanks of the great mountains and the banks of snow that never melt.

The waters in all these streams were clear and cold, and food was abundant. Some of the streams that came in from the east and others from the west already had formed considerable falls in their course above which the trout were not able to go. In some of the tributaries, such barriers were met with in the beginning and those streams are barren of fish to this day. In others, the invasion from the main stream began and was consummated before the falls became impassable, and trout are now found in them, although falls which fishes can not surmount have since been formed in many of them. Among tributary streams of this character which may be mentioned are Soda Creek, Coyote Creek, and the Little Kern on the west and Volcano Creek and South Fork of Kern River on the east. In the first three, the wearing down of the stream-bed and the formation of impassable falls prevented any subsequent invasions from the main river, isolated those colonies of trout which had pushed toward the headwaters, and prevented any further mixing of creek fish with river fish. But in Volcano Creek the conditions were exceptional and complicated. This stream derived its fish originally from Kern River, as did the other streams mentioned; impassable falls subsequently formed and the fish of the creek became shut off from those of the river. Then an unique factor was introduced. A period of volcanic activity ensued, during which the west half of the Toowa Valley was more or less filled with lava, volcanic tufa, and other igneous material, the lower half of Volcano Creek was for a time wiped out of existence, and every living thing in its waters below the tunnel killed. The only fishes of Volcano Creek that escaped this catastrophe were those individuals which had migrated well toward the headwaters

of the stream above the influence of the lava flow. But this creek was permanently shut off from any further invasions of trout from the river; and when its waters again began to flow to the Kern, the falls then formed were even greater barriers than before, and the trout of Volcano Creek became more thoroughly isolated.

The environment of Volcano Creek is very different from that of Kern River; it is that of a small stream, with clean gravelly granite bed in its upper and yellowish or blackish lava and yellowish tufa in its lower course, and with water clear, pure, cold, and turbulent. Contrasted with this is Kern River, a large stream, many yards wide and many feet deep, with current often sluggish and bed of fine sand or mud in many places.

These different environments were sure in time to modify and differentiate the fishes of the two streams. The law of cause and effect applies here as elsewhere in nature, and with equal force; different causes acting upon even the same thing will produce different results.

But geographical isolation (räumliche Sonderung) is the great primary factor in the production of new species. It is the potent agent which holds apart the two groups of individuals, preventing intermingling and confining each to the influences of its own peculiar environment.

In the production of new species in nature, it is not essential that the environments be greatly unlike, or unlike at all, if the groups of individuals being acted upon can be kept from interbreeding.

And thus the trout in Kern River and those in Volcano Creek went on developing, each group in its own way, the two becoming more and more unlike and acquiring structural and other characters by means of which the two forms may be readily distinguished. The trout of Volcano Creek has taken on characters not possessed by the trout of any other stream—very different indeed from those of the Kern River trout. These characters have become fixed, as is evidenced by the fact that they are essentially uniform among all the individuals of this creek. The Volcano Creek trout is therefore a different species from that found in Kern River.

As a result of the formation of impassable falls in the South Fork of the Kern, in the Little Kern, in Coyote Creek, and perhaps still other tributaries of the Kern, other colonies of trout that had invaded the headwaters of these streams became isolated, and in time they also became specifically distinguishable from those of the main Kern and all other streams, so that we now have, as already stated, four distinct species in the Kern River basin. They are the three species of Golden Trout, and the Kern River Trout which is the parent species from which the various species of golden trout have been independently derived.

LITTLE KERN GOLDEN TROUT.

Salmo whitei Evermann.

Other names: Coyote Creek Golden Trout; Soda Creek Golden Trout; White's Golden Trout.

Description: Head 3.22 in length; depth 3.68; eye 4.54 in head; snout 3.33; maxillary 1.72; mandible 1.66; interorbital 3.57; longest dorsal ray 2.08; longest anal ray 2.17; pectoral 1.66; ventral 2.17; caudal lobes 1.61. Body rather stout, moderately compressed; head conic; mouth large, oblique, jaws subequal; maxillary long and slender, reaching much beyond the eye; teeth on jaws,

tongue and palatines well developed; caudal peduncle deep, its least depth about equal to distance from tip of snout to middle of eye. Fins well developed; origin of dorsal somewhat nearer tip of snout than base of caudal fin; insertion of ventral about under middle of dorsal fin. Scales small, but noticeably larger than in the Volcano Creek trout.

Color in life, back and upper part of side light olive; side and back profusely covered with small roundish black spots, these extending on top of head, vertical fins, and on side below lateral line; side with 10 large roundish parr-marks and a broadish median band of light-brick or terra-cotta red; lower part of side light lemon-yellow with a number of bluish-black blotches, chiefly anteriorly, somewhat larger than similar ones on back; belly from tip of lower jaw at anal fin rich orange-red or cadmium, richest between pectoral and ventral fins, this band the full width of the belly; no red dash on throat; suborbital pale rosy or purplish; cheek brassy, with a large dark blotch; opercle rosy orange, olivaceous above; dorsal fin with about five rows of small round black spots and a black border except anteriorly, where the rays are tipped with a light-rosy border; pectoral light yellowish; ventral and anal reddish, with broad white edge; caudal profusely spotted with black like the dorsal fin. In spirits all the bright colors fade, but the black spots remain distinct. These spots are largest on the caudal peduncle, over which they are evenly distributed. They are also pretty evenly distributed over the entire side and top of head; the space along the lateral line, however, has fewer spots. Those below the lateral line extend more than halfway to the belly and are somewhat smaller than those above. About 14 spots show on side of head.

There is not much variation in color, as shown by examination of many examples. In all, the black spots completely cover the caudal peduncle and the entire length of side from median line of back to some distance below the lateral line; the top and sides of the head are always spotted. The middle line of the side and the belly are always richly colored, the parr-marks always present, and the dorsal, anal, and ventral fins bright-edged. No conspicuous red dash was observed on the lower jaw in any of the specimens from South Fork of Kaweah, Soda Creek, or Wet Meadow Creek, but among those from Coyote Creek were some showing considerable color.

Marks for field identification: The presence of small black spots on top of head and all but the lower one-third of the side distinguishes this golden trout from the two other species of golden trout.

Distribution: Soda Creek; Coyote Creek; Wet Meadow Creek; Little Kern River. The headwaters of the South Fork of the Kaweah were originally without trout but were stocked with fish from Soda Creek at Quinn's Horse Camp, and this species may, therefore, very properly be called the Soda Creek Trout.

This fish is known to reach a length of about ten inches. It takes the fly readily, and is a good fighter. Though less brilliant in color than the golden trout of Volcano Creek, it is in every respect a beautiful and attractive fish.

The following interesting account of the trout of the small streams of the High Sierras, by H. W. Henshaw, and written many years ago, applies chiefly to this species:

"This is the common brook trout of the small mountain streams of the Pacific slope, and up to an altitude of 9,000 feet it is the rare exception to find a suitable stream that is not well stocked with it. Upon many of them these trout are found in very great abundance, each pool and rapid numbering its finny denizens by the score. They may be taken in any sort of weather, at any hour of the day, by almost any kind of bait. During the heat of the day they frequent almost entirely the deeper pools, lying under overshadowing rocks or in the shade of some convenient log. In early morning or late afternoon they come out and run more into the shallows and rapids, under which circumstances they bite best and afford the finest sport. Like the average brook trout the species rarely attains any considerable size, ranging from four to eight or more inches in length. The character of the

bottom and water itself has much to do with color and I remember to have fished in a small rivulet on one of the subalpine meadows not far from Mount Whitney, whose sluggish waters flowed over a bottom of dark mud, in which the color of the trout simulated very closely its hue; they had lost nearly all the flashing irridescent tints characterizing the same species caught but a few hours before in another stream, and had become dull and somber-hued. Accompanying this change of color was a correspondingly noticeable difference in the habits and motions, and the several dozen trout caught that evening for supper were taken out by the hook with the display of very little more gaminess than would be noticed in so many horned pout. On the contrary, in the clear rapid current of the mountain stream, a flash of sunlight is scarcely quicker than the gleam of gold and silver, seen for a single instant, as the whirling waters are cut by one of the trout as he makes a rush from his lurking place for some chance morsel which is being borne past him. The Western trout are rarely as shy as their relatives of Eastern waters, and because of their numbers and consequent scarcity of food are apt to be less fastidious; yet even when most abundant due caution must be used if one would be successful, and not every one can catch trout even in the West. With the proper care in concealing one's self a pool may be almost decimated ere the alarm will be taken, and I have seen fifteen fair sized trout taken from a single small pool in quick succession."

This beautiful trout was named in honor of Stewart Edward White who suggested to President Roosevelt the investigation which resulted in its discovery.

SOUTH FORK OF KERN GOLDEN TROUT.

Salmo agua-bonita Jordan.

Other names: Mount Whitney Golden Trout; Golden Trout; Agua-bonita Golden Trout; *Salmo irideus agua-bonita.*

Description: Head 3.68 in length; depth 3.85; eye 4.4 in head; snout 4.4; maxillary 2.09; mandible 2.00; interorbital 3.66; longest dorsal ray 2.09; base of dorsal 1.8; longest anal ray 1.69; pectoral 1.63; ventral 2.00; caudal lobes 1.46; base of anal 2.1. Body stout, moderately elongate; head short, snout blunt; mouth moderate, maxillary extending somewhat beyond orbit, relatively broader than in the Kern River trout; teeth on jaws, maxillary, palatines, and vomer well developed; fins moderate; caudal peduncle compressed, its least depth equal to distance from tip of snout to posterior edge of pupil; scales relatively large.

Color in life, back and upper part of side light olivaceous; entire body above lateral line, including head, sparsely covered with rather large roundish black spots, those extending below lateral line on caudal peduncle; spots on side anterior to dorsal fin usually few; usually a few spots on median line of back between origin of dorsal and head; snout and top of head usually with a few spots; 2 or 3 spots sometimes on side of head; middle of side with a somewhat distinct rosy band, plainest at middle; parr-marks always present; side below lateral line light golden yellow; belly scarlet, brightest from ventral halfway to isthmus; under side of head, except jaw, reddish orange; cheek light golden yellow anteriorly, rosy or coppery posteriorly; dorsal and anal fins profusely spotted, the other fins with no spots, the anal dusky; adipose fin with edge black, and 2 small black spots; anterior dorsal ray tipped with reddish orange; ventrals and anal red, tipped with orange white; pectoral bronze. The above description chiefly from a specimen 7.75 inches long.

An examination of numerous examples shows some slight variations in the colors. The parr-marks are sometimes less regular, and the exact shade of the bright lateral band and the color of the belly vary somewhat. These, however, are simply differences in intensity rather than in pattern.

Marks for field identification: In this species the extent of the spotting on the body is the best diagnostic character. The South Fork of Kern trout are almost invariably well spotted, not only on the caudal peduncle but also along the side above the lateral line, at least as far forward as the front of the dorsal fin. There are also usually a few spots on the anterior part of side and along median line of back between dorsal and head; snout and top of head spotted, and usually a few spots on side of head; but there are no spots below the lateral line except on the caudal peduncle.

Distribution: South Fork of Kern River from which it has been introduced into the Cottonwood Lakes and Cottonwood Creek, and doubtless other streams.

This species was originally described by Dr. David Starr Jordan in 1893. His description was based on three small specimens conveyed to him by Mr. W. H. Shockley of San Francisco to whom they had been sent by Mr. George T. Mills, state fish commissioner of Nevada, who in turn had received them from Mr. A. C. Harvey of Lone Pine, Inyo County, California. A memorandum accompanying the specimens stated that they had been "taken by Mr. Harvey of Lone Pine, California, in a stream called by him 'Whitney Creek' (more correctly Volcano Creek), on the west side of the Sierras near Mount Whitney." It has since developed that these specimens did not come from Whitney (Volcano) Creek, but from Cottonwood Creek, a stream on the east side of the mountains and tributary to Owens Lake. Cottonwood Creek was stocked in 1876 by Messrs. A. C. Stevens, S. V. Stevens, and Thomas George with trout obtained by them in Mulky Creek, a small tributary of the South Fork of the Kern in Mulky Meadows, about 3½ to 4 miles from Cottonwood Creek. It is therefore evident that the specimens upon which Dr. Jordan based his description of *Salmo aguabonita* were descendants of the trout from Mulky Creek transplanted into Cottonwood Creek in 1876 and are therefore the same species as that of the South Fork of the Kern. A comparison of specimens taken in the latter stream in 1904 with the type and cotype of *Salmo aguabonita* shows them to be specifically identical.

ROOSEVELT TROUT.

Salmo roosevelti Evermann.

Other names: Volcano Creek Golden Trout; Golden Trout of Golden Trout Creek; Golden Trout; Golden Trout of Volcano Creek.

Description: Head 3.5 in length to base of caudal fin; depth 4; eye 5.6 in head; snout 3.4; maxillary 1.8; longest anal ray 1.9; pectoral 1.8; ventral 2.1; caudal lobes 1.8; base of dorsal 1.9; base of anal 2.6; least depth of caudal peduncle 2.6. Body stout, moderately compressed; head conic, rather long; snout long; jaws subequal, mouth large, somewhat oblique; maxillary long and narrow but slightly curved, extending much beyond orbit; teeth well developed mandible, maxillary, palatines, front of vomer, and on front of tongue, the latter in two rows; caudal peduncle very stout. Fins all strong and well developed; origin of dorsal midway between tip of snout and base of caudal peduncle; base of ventrals under middle of dorsal; caudal broad, strong, little notched when fully spread; anal with its free edge somewhat falcate. Scales exceedingly small, smaller than in any other known species of trout, nonimbricated, and scarcely showing unless dry; there are about 50 in an oblique series from front of dorsal downward and backward to the base of the ventrals; there are about 200 scales in the lateral line, 140 to 150 of them having pores.

Color in life, back, top of head, and upper part of side very light yellowish olive; middle of the side from gill-opening to adipose fin with a broad bright rosy band, the greatest width of which is about equal to greatest diameter of orbit; side below lateral line bright golden yellow, fading below into yellowish white; belly with a broad cadmium or deep orange-red band from throat to anal fin, the color deepest between pectoral and ventral; some red on belly between

origin of anal and base of caudal; about 10 roundish or vertically oblong parr-marks on middle of side, upon which apparently the rosy lateral band is superimposed; 3 of these parr-marks are on the caudal peduncle posterior to the adipose fin, 2 between the adipose and dorsal fins, 2 under the dorsal, and 3 anterior to it; between the first and second large parr-marks and somewhat below them is a small round spot of the same color, and there is a similar one between the fifth and sixth spots; cheeks and opercles bright rosy, edged posteriorly and below with yellowish, an olivaceous blotch on upper part of cheek and a small black spot on upper part of opercle; region about eye olivaceous yellow, especially below; lower jaw rosy, with some yellowish, membrane between rami of lower jaw whitish, without rosy wash, tip of lower jaw olivaceous; mouth on sides and below tongue orange, whitish elsewhere; side of caudal peduncle with about 30 small roundish black spots, these most numerous on posterior half, there being only 3 anterior to the adipose dorsal fin; rest of body entirely without spots; dorsal fin with about 6 irregular series of small roundish black spots, those toward the distal portion largest and blackest; general color of dorsal fin light olivaceous yellow, the tips of the anterior rays with a broad margin of whitish orange; adipose dorsal olivaceous, narrowly bordered with black, and with 2 small round black spots; caudal fin profusely spotted with black, the spots arranged irregularly in about 8 or 10 vertical rows; those at the base blackest and roundest, those on the distal edge somewhat linear, those on the outer edges of the lobes extending forward onto the dorsal and ventral lines of the caudal peduncle; general color of caudal fin yellowish and olivaceous, the lower lobe somewhat rosy; pectoral red, somewhat lighter than lateral band; ventral reddish, the anterior rays edged with white; anal reddish with a little orange, the anterior half or two-thirds broadly edged with white.

There is not much variation in color, except such as is probably due to difference in age; the rosy lateral band, the parr-marks, and the broad rich cadmium band on the belly are characteristic. The variation in the black spots is inconsiderable. In the 29 specimens which the senior author has examined critically 15 do not show any spots whatever anterior to the adipose fin, and only 2 of the remaining 14 show any spots anterior to the dorsal fin, and these are obscure and few in number. In one large specimen there are but 12 to 14 spots on the caudal peduncle; in another somewhat smaller example there are but 6 spots. The dorsal, anal, and ventral fins are invariably edged with color. The head in the males is longer and more pointed; the maxillary is also longer than in the females.

When well spread the caudal fin is usually slightly lunate or slightly notched, but in some examples it is almost truncate or square. In alcohol all of the bright colors soon fade, the parr-marks, black spots, and pale edges to the dorsal, anal, and ventral fins persisting. The general color of the body then becomes a dirty yellowish white or in some specimens brownish. In some cases the parr-marks almost wholly disappear.

Marks for field identification: The rich rosy lateral band showing through the large distinct bluish-black parr-marks, the rich lemon-yellow of the lower half of the side, the intensely rich cadmium of the belly, and the entire absence of black spots on the body except on the caudal peduncle, readily distinguish the Roosevelt trout from all other species.

Distribution: The golden trout is native to Volcano Creek alone, and occurs throughout the entire length of that stream. It is found at all places from above the tunnel to below the lowermost of the series of falls near the mouth, and in all suitable places from the tunnel to the headwaters above Volcano Meadows, where the elevation is more than 10,000 feet.

Trout are abundant in Volcano Creek; every pool at the foot of a fall or below a cascade or rapid is sure to contain a number of them, and they may be seen on the riffles and under the protecting banks. Although the fish runs down Volcano Creek even to below the lowest falls, it apparently does not venture out into Kern River; no examples were seen there. It is a creek fish and appears to keep within the peculiar environment of the small stream. They are most numerous above the tunnel, probably because fewer tourists visit that portion of

the stream. The fish there, however, are usually small. The largest, finest examples are found between the natural bridge and the lower falls.

As a game fish the golden trout is one of the best. It will rise to any kind of lure, including the artificial fly, and at any time of day. A No. 10 fly is large enough, perhaps too large; No. 12 or even smaller is much better. In the morning and again in the evening, it will take the fly with a rush and make a good fight, jumping when permitted to do so; during the middle of the day it rises more deliberately and may sometimes be tempted only with grasshoppers. It is a fish that does not give up soon but continues the fight. Its unusual breadth of fins and strength of caudal peduncle, together with the turbulent water in which it dwells, enable it to make a fight equalling that offered by many a larger trout.

Although now abundant the golden trout can not long remain so unless afforded some protection. The attractiveness of the Kern River region because of its scenic beauty is sure to appeal more and more to tourists every year. Practically the entire length of Volcano Creek is easily accessible from the trail from the east side of the divide. As a matter of fact, one can in one day travel the entire length of the creek and have time to stop frequently to drop a fly into the pools which he passes. The trout are readily found and easily captured, as they are so voracious and rise to the lure so readily.

The great beauty of the Roosevelt trout lies in the richness of its colors and in its trimness of form; the brilliancy and richness of its coloration is not equaled in any other known species of trout. The delicate golden olive of the head, back, and upper part of the side, the clear golden yellow along and below the lateral line, overlaid by a delicate rosy lateral band, and the marvelously rich cadmium of the under parts, fully entitle this to be known above all others as *the* golden trout. Except on the caudal peduncle, the body is entirely without the black spots characteristic of the rainbow trout series. One can appreciate to some extent the great beauty of this fish by examining the splendid painting by Hudson.

In form it is no less beautiful; its lines are perfect, the fins large and well proportioned, and the caudal peduncle strong; all fitting it admirably for life in the turbulent waters in which it dwells. It is a small fish, however. It is probable that it never attains a greater length than 14 inches or a weight of more than a pound in Volcano Creek. In the Cottonwood Lakes it is said to reach a weight of five pounds.

The scales are smaller than in any other known species of trout. They are so small, indeed, as to have caused so good an observer as Stewart Edward White to declare that this trout has no scales at all. This is an error in observation that is not uncommon; even James Russell Lowell, excellent naturalist that he was, wrote:

> "One trout scale in the scales I lay
> (If trout had scales), and it will outweigh
> The wrong side of the balances."

But all trout have scales, albeit often very small and not easily seen except by him who knows fishes, and the golden trout scales are the smallest of them all.

This, the most beautiful trout in all the world, was named in honor of Theodore Roosevelt, the naturalist, who, as President of the United States, ordered the investigation which resulted in its discovery as a new species.

Cutthroat Series.

CUTTHROAT TROUT.

Salmo clarkii Richardson.

Other names: Black-spotted Trout; Columbia River Trout; Clark Trout; Red-throated Trout.

Description: Head 4; depth 4; D. 10; A. 10; cæca 43; scales small, in 150 to 170 cross-series. Body elongate, compressed; head rather short; mouth moderate, the maxillary not reaching far beyond the eye; vomerine teeth as usual set in an irregular zig-zag series, teeth on the hyoid bone normally present, but often obsolete in old examples; dorsal fin rather low; caudal fin slightly forked (more so in young). Color, silvery olivaceous, often dark steel color; back, upper part of side and caudal peduncle profusely covered with rounded black spots of varying sizes and shapes, these spots often on the head, and sometimes extending on the belly; dorsal, adipose, and caudal fins covered with similar spots about as large as the nostril; *inner edge of the mandible with a deep-red blotch*, which is a diagnostic mark; middle of side usually with a diffuse pale rosy wash, sometimes quite bright, and extending on side of head; under parts silvery white. The red blotches or washing on the membrane joining the dentary bones of the lower jaw are usually constant, probably always present in the adult, and constitute a most important character. (Jordan and Evermann)

Marks for field identification: Red marks on throat; very small scales, there being about 150 in a row from head to tail; back profusely spotted; teeth present on hyoid bone at base of tongue.

Distribution in California: Pit River and tributaries, Eel River, coastal streams of northwestern California, Goose Lake.

Spawns in spring. Decidedly a deepwater fish, except during spawning season when it seeks shallower waters. Cutthroats do not rise as readily to a fly as other trout, but more often take a sunken fly; nor do they seek swift water as the rainbow. As a rule, this species does not rank with others in its gameness. Apparently, the cutthroat in this state is not as prolific as the rainbow; at least this species is not nearly so abundant as the rainbow. The cutthroat spawns in the spring and early summer, ascending to the headwaters of streams or depositing eggs in shallow water or on sand bars in the lakes. Lake cutthroats invariably reach a larger size than stream fish. Specimens in the Klamath Lakes have reached a weight of seventeen pounds.

TAHOE TROUT.

Salmo henshawi Gill & Jordan.

Other names: Black-spotted Trout; Silver Trout; Redfish; Tommy; Black Trout; *Salmo tahoensis; Salmo purpuratus henshawi; Salmo mykiss* (in part); *Salmo mykiss henshawi; Salmo clarkii henshawi.*

Description: Head 3.75; depth 4; D. 11; A. 12; scales 27 to 37-160 to 184-27 to 37, usually about 170 in a longitudinal series; body robust, elongate, greatest depth about one-fourth of total length without tail; caudal peduncle about two-fifths length of head; head long, conical, slender, not extending far behind eye; two long series of vomerine teeth; caudal short and distinctly forked; dark olive-green above, covered almost entirely with large black spots; males a dark yellowish-olive color, with metallic reflections, the dark color being the same

from the back to the ventral surface; a broad, pinkish, indefinite stripe about 10 scales wide on the side, each scale included in this stripe and also in a broad area above and below slightly edged with light yellow; opercle, preopercle, subopercle, and a triangular spot above the axil of pectoral, scarlet or yellowish scarlet; under surface of lower jaw with two parallel stripes of red; red also visible on the tongue and on the shoulder-girdle; brownish-black spots distributed over the entire body; females usually more lightly colored, and the colors seeming to have more metallic luster.

Marks for field identification: The dark olive body with many bold black spots widely scattered almost uniformly over its entire surface, and the red marks on the throat distinguish the Tahoe trout. Sometimes it has a silvery luster. Although plainly belonging to the cutthroat series, having the same red dashes under the throat, long head, small scales and teeth on the tongue, it is nevertheless, browner or yellower in color, and has larger scattered spots which cover the whole fish.

Distribution: Lake Tahoe and its tributary streams and lakes, upper portions of the Truckee River, Donner, Webber, and Independence lakes; introduced in lakes of Siskiyou County, and Bear Lake, San Bernardino County, and in the Stanislaus and the Mokelumne rivers on the western slope of the Sierras.

Anglers usually point out the following different kinds of trout in Lake Tahoe and the Truckee River:

Tahoe Trout, dark in color with large spots.

Silver Trout, silvery in color, with small, elongate spots, body deep and heavy.

Redfish, brilliant in color, with red cheeks.

Tommy, small, relatively large spotted fish, spawning later than the redfish.

Royal Silver Trout, deep blue above and silvery on sides with few or no spots. (*Salmo regalis.*)

Even though known to fishermen, these forms with the exception of the royal silver trout are here all classed as Tahoe trout, until further information is available.

There has been a great deal of speculation over the identity of the redfish, a large brightly-colored fish with a red cheek spot, which runs up the Truckee River early in spring, the migration ceasing in March. By many this is regarded as entirely distinct from the Tahoe trout. With the conclusion of this run of fish there appears a run of smaller fish known to the anglers as tommies. This second migration usually occurs in April and is about over by May 1. The tommy is a smaller and relatively large spotted fish. Whether these two forms which have separate spawning seasons are one and the same fish is yet to be determined, but at present they are given the same name. (Snyder.)

Frequently, a very light-colored silvery example of Tahoe trout is taken, its sides having a bright metallic luster and smaller and more elongate spots. This is usually known as the silver trout, and is said to frequent the greater depths. It attains a very large size, one having been caught which weighed 29 pounds. This form was described by Jordan and Evermann as *Salmo tahoensis* and may be, as they thought, a distinct species.

During a portion of the year the Tahoe trout lives in deep water, and can be caught, if at all, only on long lines. Early in the spring

and in the summer they are to be found in relatively shallow water. It may be that food supply accounts for this migration from deep to shallow water, as spawning minnows seem to be the attractive food when the trout is in shallow water. The greater number of this species are taken by trolling with a spoon. (Snyder.)

The Tahoe trout appears to feed largely on minnows but black ants and other insects are taken in quantity.

ROYAL SILVER TROUT.

Salmo regalis Snyder.

Other names: Greenback; Grayback.

Description: A fresh specimen is characterized by a deep steel blue on the dorsal surface which color extends downward on the sides to about the sixth row of scales above the lateral line, where it abruptly blends into a silvery hue. The silver dulls ventrally, while the chin, throat, and abdomen are white. The cheek is marked by a faint red or yellow spot glowing faintly through the silver, but this is the only red or yellow color on the fish. The dorsal and caudal fins are the only portions of the body marked by dark spots, but even these are inconspicuous. It has about 144 to 150 lateral series of scales, 29 to 31 above the lateral line, 11 to 13 branchiostegals, and 19 to 21 gillrakers. No external sex differences can be observed. (Snyder)

Marks for field identification: The Royal Silver trout, easily confused with silvery specimens of the common Tahoe trout (*Salmo henshawi*), differs from the latter in its decidedly silvery sides, blue back, shorter head, shorter and more rounded snout, smaller maxillary, large scales, narrow and more pointed fins, perfectly smooth basi-branchials which are without teeth, and fewer gillrakers. The absence of spots is also characteristic.

Distribution: Known only from the Lake Tahoe basin.

Little is known about its habits, but apparently it does not spawn in streams tributary to Lake Tahoe, as does the Tahoe trout. Feeds largely on insects, but doubtless also takes minnows, as it has been caught on a spinner.

Native Charrs.

DOLLY VARDEN TROUT.

Salvelinus parkei (Suckley).

Other names: Malma; Salmon Trout (Alaska and Montana); Bull Trout (Idaho); Western Charr; Oregon Charr; *Salvelinus malma* (in part).

Description: Head 3.5 to 3.75; depth 4.8 to 6; eye 6.5 to 7; snout 3 to 4; maxillary 1.7 to 3; D. 11; A. 9; scales 39-240-36; pyloric cæca large, 45 to 50; gillrakers about 8 to 12. Body rather slender, the back somewhat elevated, less compressed than in *Salvelinus fontinalis;* head large, snout broad, flattened above; mouth large, the maxillary reaching past the eye; fins short, the caudal slightly forked or almost truncate. General color, olivaceous, the sides with round red or orange spots nearly as large as the eye, the back with similar but smaller spots, and without reticulations, a feature of coloration which at once distinguishes this from all other American trout; lower fins colored much as in *S. fontinalis*, dusky with a pale stripe in front, followed by a darker one. (Jordan and Evermann.)

Marks for field identification: Distinguished from true trout and from other charrs by the lack of reticulations or mottling in its color pattern. Large orange or red spots on the back as well as sides, and the lack of blackish marblings on the upper fins, distinguish it from the Eastern Brook trout. It may weigh, when mature, anywhere from six ounces to twelve pounds. The little ones are brightest in color.

Distribution: The only stream in California in which the Dolly Varden trout is known to be a native is the McCloud River.

The Dolly Varden is more voracious than the true trout. In Alaska streams it devours millions of salmon eggs, as well as young salmon and this fish is the greatest enemy the salmon breeder finds. Gamy and vigorous, it makes a fair game fish, taking a baited hook freely. They also rise readily to the artificial fly. Their food is principally minnows. In California, the Dolly Varden is largely nonmigratory. It lies on the bottom and waits for food to come to it, then grabs it like a mad bulldog. When caught it will often actually attempt to defend itself by biting. Moreover, it will live longer out of water than other trouts.

When this fish was taken by scientists in the McCloud River, the resemblance to a dress goods with spots called Dolly Varden and which was then the rage, led to its being given this name by the lady members of the party, and "Dolly Varden" it has been ever since.

Fig. 43. Dolly Varden trout (*Salvelinus parkei*). A charr, not a true trout, found in this state only in the McCloud River.

Introduced Species.

EASTERN BROOK TROUT.

Salmo fontinalis (Mitchill).

Other names: Brook Trout; Speckled Trout; Fontinalis.

Description: Head 4.5; D. 10; A. 9; scales 37-230-30; gillrakers about 6+11; body oblong, moderately compressed, not much elevated; head large, but not very long, the snout bluntish, the interorbital space rather broad; mouth large, the maxillary reaching beyond orbit; eye large, somewhat above axis of body; caudal fin slightly lunate in the adult, forked in the young; adipose fin small; pectoral and ventral fins not especially elongate. Color, back more or less mottled, marbled, or barred with dark olive or black, without spots; red spots on side rather smaller than the pupil; dorsal and caudal fins mottled with darker; lower fins dusky, with a pale, usually orange, band anteriorly, followed by a darker one; belly in the male often more or less red. (Jordan and Evermann.)

Marks for field identification: Small imbedded scales making the fish appear scaleless; mottled or marbled color pattern of back with no spots, and red lower fins fringed with white, are the best distinguishing features.

Distribution: Tahoe region, Sierran lakes and streams; planted in most streams from Siskiyou to San Diego County, with the exception of the coastal streams. This fish now has the widest distribution, in California, of any introduced species.

Eastern brook trout abound chiefly in cold, slow-running meadow brooks; but they thrive in all pure cold waters which contain sufficient

—*From drawing by Charles Bradford Hudson*

EASTERN BROOK TROUT *(Salvelinus fontinalis)*

air, including lakes and ponds. Never, in California, are they found in fast-rushing mountain streams. This fish is wary, and great skill is required in catching it. The outstanding peculiarity of its habits is evidenced by the fact that a person acquainted with its haunts can go out and catch a string of Eastern brook in a comparatively short time, while others, with better tackle and equal skill, will fish a whole day for them in vain. The largest brook trout are found in the deep, wide pools in the warmer waters; the smallest ones are found in the cold, narrow mountain rivulets near their source. Eastern brook trout do not keep well nor ship well, probably on account of the fat. They spawn high up in the tributary streams and so early (October to January) that eggs for hatchery purposes are almost impossible to obtain. This trout is a nest-builder. "Cavities are made in gravel, the nest is shaped with the tail. * * * After the eggs are deposited they are covered with gravel. The egg is about one-fifth of an inch in diameter, and varies in color from pale lemon to orange red. The average yield of the female is from 400 to 600. The period of hatching will depend on the temperature, ranging from 165 days in water of 37 degrees to 32 days in water of 54 degrees. The yolk sack is absorbed in from 30 to 80 days, and after its absorption the young fish begins to feed. The rate of growth will, of course, depend on the amount of food consumed. In artificial culture yearlings, according to Mr. Ainsworth's estimate, will average 2 ounces; fish of two years, 4 ounces; of three years, 8 ounces, and of four years, 1 pound." (Bean.)

History. The California Fish Commission purchased 6,000 Eastern brook trout in 1872, and distributed them equally in the North Fork of the American River, in the headwaters of Alameda Creek, and in the San Andreas reservoir, near San Francisco. In 1875, a large shipment of eggs, 60,000, was received from New Hampshire and succeeding shipments in 1877, 1878, and 1879. Beginning in 1890, large numbers have been hatched and distributed each year. More recently, eggs for the hatcheries have been secured from the Marlette-Carson hatchery in Nevada.

BROWN TROUT.

Salmo fario Linnæus.

Other names: von Behr Trout; European Brown Trout.

Description: D. 13-14; A. 10-11; P. 13; V. 9. Scales 25-20-30; pyloric cæca 38-51; vertebræ 57-58. Body short and stout, its greatest depth being contained about four times in the length without the caudal. The caudal peduncle is short and deep, its depth equal to two-fifths of the length of the head. Length of head is one-fourth of total length without caudal. Dorsal fin is nearer to tip of snout than to root of tail; longest ray of this fin equals the distance from the eye to the end of the opercle. Ventral is under the posterior part of the dorsal; its length is about one-half that of the head. The adipose dorsal is over the end of the anal base. Pectoral nearly one-sixth of length without the caudal. In the male the jaws are produced and very old ones have a hook. The maxilla extends to the hind margin of the eye. On head, body and dorsal fin are numerous red and black spots, the latter circular or X-shaped and some of them with a pale border; yellowish margin usually present on the front of the dorsal and anal and the outer part of the ventral. The dark spots are few in number below the lateral line. The ground color of the body is brownish or brownish black, varying with food and locality. (Bean.)

Marks for field identification: The back and sides of this trout are decidedly brown; the back is covered with black spots and the sides with red spots. The belly is silvery white or brownish. This trout is not easily confused with others.

Distribution: A pure strain is to be found in the Yosemite Valley region; streams of northern Humboldt and Lake County. Hybrids, the result of a cross with the Loch Leven, are found in many other streams in the state.

The brown trout lives in clear, cold, rapid streams and at the mouths of streams tributary to lakes. It grows to be of large size; maturing at about 8 inches in length. In its movements it is swift, and it leaps over obstructions like the salmon. It feeds usually in the morning and evening, is more active during evening and night, and often lies quietly in deep pools or in the shadow of overhanging bushes and trees for hours at a time. Insects and their larvæ, worms, mollusks, and small fishes

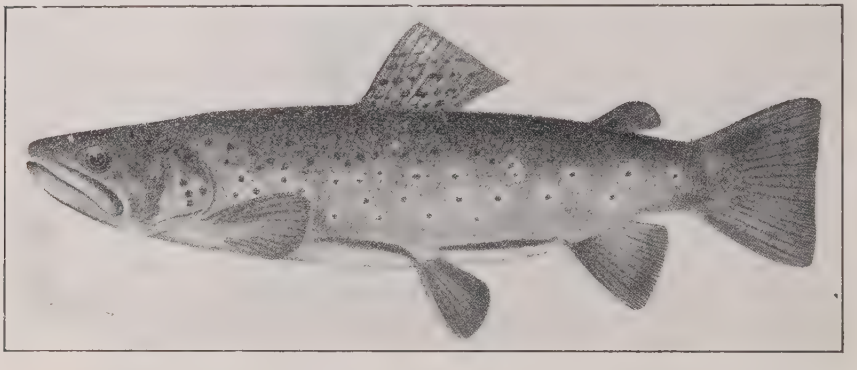

Fig. 44. Brown trout (*Salmo fario*) introduced into California about 1895. Now distributed widely in our state.

form its food, and, like its relative, the rainbow trout, it is fond of the eggs of fishes. Spawning begins in October and continues to January. Eggs are deposited in crevices between stones, under projecting roots of trees, and sometimes in nests excavated by the spawning fishes. The parents cover the eggs to some extent with gravel. (Bean.)

History. Several plants of brown trout were made by the United States Bureau of Fisheries previous to 1895, but in that year 135,000 were reared at the Sisson hatchery. With the exception of those held in the breeding ponds these fish were planted in the lakes and streams of the high Sierras.

LOCH LEVEN TROUT.

Salmo trutta levenensis Walker.

Other names: *Salmo levenensis;* Scotch Trout.

Description: D. 13; A. 12; P. 14; V. 9. Scales 24 to 28—118 to 130—26-30; pyloric cæca 47-90; vertebræ 56-59. Body slender and elongate, its greatest depth contained four and one-fourth to four and one-half times in total length without caudal. Caudal peduncle slender, its least depth three-eighths of the greatest depth of the body, and equal to length of snout and eye combined. Head rather short and conical, its length two-ninths to one-fifth of the total length without caudal. The snout is one-fourth or slightly more than one-fourth as long as the head. The interorbital space is somewhat convex, its width equal to three-fifths of the length of postorbital part of head The eye is of moderate size, its long diameter contained five and one-half to six times in the length of the head, and equalling about twice the greatest width of the maxilla. Maxilla reaches to or slightly beyond the hind margin of the eye. Teeth rather strong, those in the intermaxillary and mandible the largest, triangular head of vomer with two or three in a transverse series at its base,

teeth on the shaft of the vomer usually in a single, partially zig-zag, persistent series. Mandible without a hook and little produced even in breeding males. Dorsal origin distant from tip of snout about as far as end of dorsal base from base of caudal; the dorsal fin higher than long, its longest ray equal to longest ray of anal fin. The anal fin is much higher than long, its distance from the base of the ventral equaling length of the head. The ventral origin is nearly under the middle of the dorsal, the fin being as long as the postorbital part of the head. Pectoral equals length of head without the snout. Adipose fin very small, its width one-half its length, which is about equal to eye. Caudal fin emarginate unless fully extended, when it becomes truncate, the outer rays about one-seventh of total length, including caudal. (Bean)

Marks for field identification: The true Loch Leven trout is a slimmer fish than the brown trout, and the adipose fin is smaller. Furthermore, it is fully spotted and lacks the brown color of the brown trout. The sides are silvery with a varying number of X-shaped black spots or rounded brown or black spots.

Distribution: Webber Lake in Sierra County has pure original stock. Common to California streams: Feather River, Tahoe region, and Siskiyou County lakes and streams, but usually crossed with brown trout.

The spawning season may begin in October and continues till January. According to W. H. Shebley, the egg is slightly smaller (260 to a fluid ounce) than the egg of a rainbow (220 to a fluid ounce) but larger than that of an Eastern brook (345 and 400 to fluid ounce).

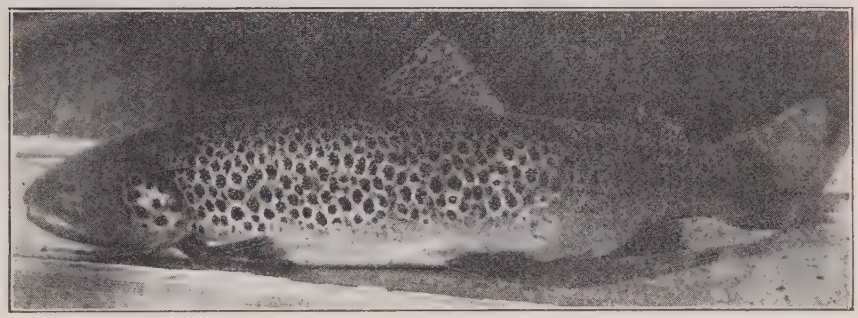

Fig. 45. Loch Leven trout (*Salmo levenensis*). A native of Scotland. Introduced into California in 1894, and now a common fish in Sierra streams, but often crossed with the brown trout.

This trout is largely nonmigratory in its native habitat. It takes the artificial fly readily. The food of this species includes fresh-water mollusks, crustaceans, worms, and small fish.

History. Twenty thousand Loch Leven trout eggs were received at the Sisson hatchery in 1894. Since that time plants have been made annually from the fry reared at this hatchery. Most of the fish in the breeding ponds at present are hybrids secured by crossing with the brown trout. Hybridization between these two species is very common.

MACKINAW TROUT.

Cristivomer namaycush (Walbaum).

Other names: Great Lakes Trout; Cristivomer; among the Canadian Indians called the "namaycush."

Description: Head 4.25; depth 4; eye 4.5; Br. 11 or 12; D. 11; A. 11; scales 185 to 205; maxillary 2; interorbital 4. Body long; head very long, its upper surface flattened; mouth very large, the maxillary extending much beyond the eye, the

head and jaws proportionately lengthened and pointed; caudal fin well forked; adipose fin small; teeth very strong. General coloration, dark gray, sometimes pale, sometimes almost black, everywhere with rounded pale spots which are often reddish tinged; head usually vermiculate above; dorsal and caudal reticulate with darker.

Marks for field identification: Largest of all trouts and known by its cream-colored or grayish spots instead of red spots as in the true charrs. The dorsal and caudal fins are marked.

Distribution: Introduced in Lake Tahoe, Fallen Leaf and Donner lakes, where it is occasionally caught.

Omnivorous in its feeding habits; it has a ravenous appetite, greedily devouring all kinds of fishes possessing soft fins. It is even said that jackknives, corncobs and other equally indigestible articles have been found in its stomach. It spawns on reefs and lives in deep water at other times. The spawning season begins late in September, and spawning continues until December.

The Mackinaw trout reaches a much larger size than a charr, specimens of from 15 to 20 pounds weight being not uncommon, while it

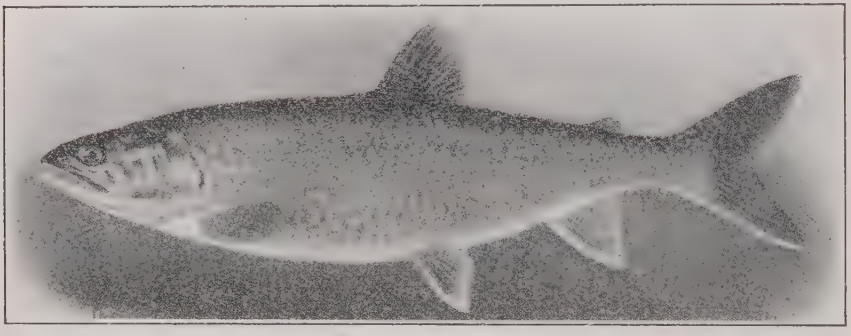

Fig. 46. Mackinaw trout (*Cristivomer namaycush*). A large trout native in the Great Lakes. Now occasionally taken in the Tahoe region, where it was introduced in 1894.

occasionally attains a weight of 50 to 80 pounds in the Great Lakes. As a food fish it ranks high, although it may be regarded as somewhat inferior to the brook trout or the whitefish. Compared with other salmonoids, the Great Lakes trout is a sluggish, heavy, and ravenous fish. "According to Herbert, a coarse, heavy, stiff rod, and a powerful oiled hempen flaxen line on a winch, with a heavy sinker; a cod-hook baited with any kind of flesh, fish, or fowl—is the most successful, if not the most orthodox or scientific mode of capturing him. His great size and immense strength alone give him the value as a fish of game; but when hooked he pulls strongly and fights hard, though he is a boring, deep fighter, and seldom if ever leaps out of the water, like the true salmon or brook trout." (Jordan.)

History. First brought to California in 1894, the Mackinaw trout was propagated at the Sisson hatchery, and the following year 65,000 were planted in Lake Tahoe. In succeeding years additional plants were made in the Truckee basin. This fish has not thrived as well as other introduced species.

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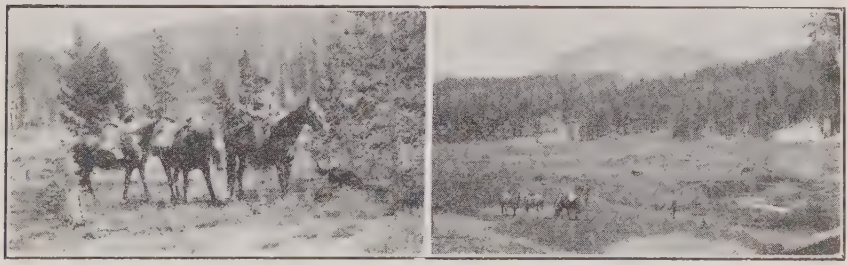

Fig. 47. Planting fish in the High Sierras.

SUMMER ON THE CALIFORNIA TROUT STREAMS.

By ROBERT PAGE LINCOLN, Associate Editor of "Rod and Gun in Canada."

Trout fishing California has in plenty, with the added attraction of picturesqueness afforded by cool valleys, and overlooked by towering mountains. There is a wide variety to choose from; and that the sport is of the very best is annually attested by the experiences of thousands of the sons of Walton who hie them away for a try at the big fellows. They generally come back with what they went for, and some memories, too, that are enlivened with bright lights that are prone to linger long in the consciousness; on the other hand, it is doubtful if such memories ever pass out of one's hoard of recollections.

It is the pride of California to know that it has a native trout that has gone down to fame, and has taken up its home in practically every quarter of the world. Just how many of the people of the Sunny State are aware of this I do not know, but that brilliant clan, the California league of fly-rod men, are in understanding of it. The fish I have reference to is the rainbow trout (*Salmo irideus*), the most noble finny fighter that ever seized an artificial fly and made a leaping, dazzling flight through the waters. In the Eastern section of the country men speak volumes about the speckled brook trout, though each and every one of them end up, at some time or another, by telling of the fight that the rainbow trout puts up when captured. As an introduction into other waters, the native Californian, rainbow trout, has proven himself well able to take care of himself and to perpetuate his kind for the benefit of anglers. The rainbow trout is now found in the waters of the British Isles, in France, Germany and Russia. Exceptionally good rainbow trout fishing is to be had in the many rivers of South Africa. Anglers have written enthusiastically of fishing for *Salmo irideus* in the streams of New Zealand. In our own country the rainbow trout has had a wide distribution. Knee deep in the waters of Michigan and Wisconsin streams I have played this fighter—the pride of California; reared at the foot of the snow-capped mountains, in the heart of the Sierras. In the rage that swept the Eastern States over speckled brook trout fishing, a condition has arisen where practically every stream has been sapped of its spotted beauties. Where to turn for a replenisher? The rainbow trout is always the happy solution. There is not a properly-fitted trout stream that will not do for the rainbow trout. It grows fast. It fights well.

But it seems that only in the shadow of their beloved mountain home (as in the Sierras) do the rainbow trout give a befitting example of their sprightly dash and pugnaciousness. One who has tested the fighting leap and flight of a rainbow trout, in its own particular native waters, in the mountains, and has tested a fish of the same species in Eastern waters at once knows the difference. Still flowing, often quite warm, and often discolored streams (which the rainbow trout has been introduced into in the East) produce a slow-moving fish with little fight in him. Such fish speedily degenerate into gluttons, and keep themselves in the pools. Many of these hulking fellows finally get to hugging the bottom and rarely come to the surface to take a fly.

How different the mountain rainbow! Unused to warm water, like the brook trout, he demands the sweet, cold water. By reason of the swiftness of the mountain stream he has a vigorous "kick" to his tail. His fins are superlatively strong for breasting those crystal currents. When he takes your artificial fly he does not lazily rise to the surface to suck it in, but snaps it. A moment later he will turn a double or triple somersault and the fight is on. 'Ware of that light tackle! He is a match for you. Back and forth he will race from one edge of the stream to the other. He is cunning, too, and knows every log and obstruction in the stream. He will (if you do not watch out) snag your leader on a convenient boulder and there will be nothing left but the fragrant memory of what might have been. The mountain rainbow is a high flyer, with the guarantee of gameness linked with his name. It recalls the brilliant words of Charles Frederick Holder: "How that rainbow came at me; how it went repeatedly into the air; how I nearly fell overboard, are matters of personal history, and need not be dwelt upon; but for the first few seconds that living rainbow, which went pirouetting over the little river on its tail, throwing impossible aerial swings and leaps, filled a space in my imagination. Again and again the rainbow leaped, a silvery radiance flashing in the sunlight, dropping back to dash about the boat, to come in with a rush, faster than I could reel. * * *

"You have, perhaps, never seen a big rainbow fresh from the icy pools of its choice. Know, then, that this fish, this seven-pounder which I held upon the scales, was a thing of beauty, a joy forever beyond dispute. Its back was well sprinkled with ocelot-like black spots; the color a deep green, the lower surface silver, while over all seemed drawn a filmy gauze of old-rose fabric, of inexpressible delicacy and beauty, which was intensified along the median line in a band of pink and rose and other tints that produced all the colors of the rainbow, for truth, and gave this radiant creature rank among the birds of brilliant plumage."

Holder wrote of the large rainbow trout to be taken in the lakes and streams of northern California and southern Oregon. How skillful was this great California angling writer in telling the beauty of fishes, and the fascination in taking them? No one has equalled his efforts at word painting with black upon white.

When one speaks of rainbow trout in California one instinctively thinks of the Kern River, which finds its birth in the high Sierras. The waters from Mount Whitney pour into that beautiful stream, "a great, clear, green, swift stream, among the granite rocks, its waters slipping along like oil; a river with rippling shallows and deep, cold eddies, the perfect home of the trout." The Kern River is famed among anglers the world over. When anglers meet it is always: "Have you ever fished the Kern, of California?" If you have fished the Kern you are the center of a curious throng of interested listeners. Especially does the Kern River interest anglers in that some of the tributaries from Mount Whitney contain a trout that is one of the gentle wonders of this planet. I refer to the so-called golden trout. Professor Gilbert brought out the first specimens of this fish for identification. David Starr Jordan designated the fish *Salmo gilberti*. That was some twenty years ago. The fish was brought from Soda Springs on the

south fork of the Kern River. Later the isolated golden trout of Volcano Creek were designated as a species apart from the others, the scientific term being given them (*Salmo agua-bonita*).* This name was derived from the waterfall that separates the Volcano Creek from the rest of the world—that is, as far as coming and going concerns this trout. There are scientifically, three species of the so-called golden trout in the Mount Whitney waters; overcast in gold, the fins tinted in the purest orange with a nicely brushed-in orange colored stripe along the median line. The golden trout are an off-shoot of the rainbow trout; merely that changed environments have wrought a subtle transformation in their coloration, for the pigment cells of a trout are very sensitive to taking on a new coloration. If a stream bottom be of sand and gravel, and very bright, the fish attains to a silvery coloration. The golden trout owe their coloration to the color of the bottom of the stream they live in. "The rocks over which these streams flow," says Jordan, "are of bright granite and quartzite, gray and red. It is supposed that the color is protective, for the fish are colored like the bottom. To a bird looking into the stream, the deception is perfect. It is supposed (though no one knows) that the colors have been attained through natural selection. The redder the fish, the better its chance to escape the fishhawk and eagle. If this is not the cause of the color, no one can guess any other, and to escape its enemies through resemblance to natural objects is not a trait of the fish alone, but of hundreds of other creatures in these and other mountains. But whatever the cause, nothing in nature is more beautiful or more graceful than a golden trout, alive in these clear, icy, sun-lit waters."

The golden trout are trout of the high altitudes. Such trout rarely grow to length and breadth and weight. One rarely catches a true golden trout much over three-quarters of a pound in weight. They rarely go over twelve inches in length; a ten-incher may be taken as a large one. They attain to maturity at a length of about eight inches. Sadly, they are unwise, being so far removed from man, and they take the fly with a dash and at the first cast that leads many a fish hog to catch ten times more than he should. Quieter stretches of water (as where it flows through the meadows) provide good fishing. The trout angler will find joy in taking a very few of these exceptional fishes and enjoy the thought that he is in a region that, for beauty, it is hard to equal.

Unknown to many, the size of the stream, the river or the lake that a rainbow trout is found in has its effect upon the size of the fish. The reason of this is two-fold: first, the size of the stream; second, the smaller amount of food that it produces. It is for this reason that the rainbow trout often mature when they are six inches in length, in the streams of the high altitudes. They will ravenously seize the artificial fly, believing it food, for there is a scarcity of it, and therefore its attractiveness is instantaneous. In the slightly larger streams the rainbow trout attain to weights of about two or three pounds. In still deeper streams and large pools four-pounders are not uncommon. The Kern, the Kings and the Merced rivers are representative rainbow

*It was later learned that the specimens to which Dr. Jordan gave the name *Salmo agua-bonita* really came from Cottonwood Creek, into which they had been introduced from South Fork of Kern River, and that the trout of Volcano Creek is a very different species, which Dr. Evermann named *Salmo roosevelti*. See pages 124-125.

streams. In the lakes (as in Kern Lake) the rainbow trout reaches to a weight of eight pounds. In the Klamath Lakes rainbow trout have been taken as high as twenty-five pounds in weight. The ocean-running rainbows are large; they are salmon-like fellows. They feed heavily in the ocean and thus attain often gigantic weights. In the ocean their beautiful fresh-water coloration fades and they become silvery in coloration. They generally come up to the coast rivers in the month of March to spawn.

Summer on the California trout streams is one of joy unending and success in due measure. Nevertheless, it is strange what a falling off occurs in the number of anglers who visit the streams in the latter part of July and August. Opening days are always attended by outward moving delegations of anglers; and the streams are thickly peopled. Later on, however, they dwindle down to twos and threes—and the streams are left to themselves. A certain number of these sons of Walton know that the best fishing occurs when the heats of summer lower on the earth, for it is then the mountain waters yield up their fairest specimens. Those secluded pools are then veritable treasure-places and bear a careful looking into; it takes skill and the correct lure, but the wise angler is never wanting in fitting perfectly into the situation. Live bait, spinners and artificial flies are used. The live-bait man knows that the grasshopper is a telling lure what time the July sun is gilding the heavens and is never to be found near to the waters then without a box of them. How to use them on the hook without impaling them? Simply procure some of the smallest druggist rubber snaps. Take a sufficient number of turns of the rubber around the hock, bend and then insert the hopper in the loop. Helgramite are attached to the hook in the same manner and they will still be as alive as ever. The druggist rubber snap is a bait-saver, and no mistake. One may catch fifty trout (if it so be) on a helgramite, attached to the hook with a snap, and at the end of the day's fishing it will be as active as ever. The larvae of the Dobson fly (which is the helgramite) are only too well known to the live-bait fisher. They are those wicked-looking creatures one finds in the streams upon turning up stones. They have a series of pincers on each side, though they are more savage in appearance than in actual combat. It has been said that when all else in the line of bait fails, the helgramite, the grasshopper and the angleworm will win.

And there is method in the skillful use of the angleworm, too. In fact there is an art, in itself, to "working for trout," as it is called. Your chuck-and-chance-it, live-bait fisherman will hook on a great gob of worms; will start it at the head of a pool and will let it tumble, haphazard down with the current, rolling over the bottom of the stream. Some rainbows may see it, and take it, no doubt, but not the fish you are looking for. The true sportsmanlike method of worming for trout consists in connecting a bare hook to a spinner—a No. 1 or 2 spinner will do nicely. To this bare hook the worm is attached so that it will trail in the water. Instead of driving the hook throughout the worm, it is hooked just under its skin. It requires some little art to cast this—in fact, it is not a cast at all, but is allowed to play out in the water. The spinner will whirl, throwing off a silvery ray, and the long, trailing worm will have a snaky, wavering motion in the water

that proves instantly attractive. Move this into some suspicious-looking mountain pool and if there is a large rainbow trout there he will be interested in sampling your offering, be it feeding time or no. It is hard, in the finny world, to refuse an angleworm that trails so subtly and enticingly in the water.

However, the safest and most certain method in using the angleworm for a lure goes as follows, and has never been known to fail at getting the fish that strikes: A No. 10 is slipped on to a leader and is tied to the leader one and one-half inches from the end of it. The hook should not stand out from the leader; rather the hook shank should lie along the leader. This done, a second hook is tied on to the leader at the end, to be the lead hook, the front hook, so to speak. Now the worm is connected to this affair, the head of the worm being attached to the back hook, while the front hook is worked into the body. To all appearances when this is moved in the water the worm is free; this is especially true if you are using an invisible leader, of which there is at least one on the market. When a fish strikes this worm he will hook up either to the first or the second hook on the leader, or both. There is hardly a chance here of nipping off the end of the worm for the simple reason that there is a hook in it.

It seems strange, but nevertheless a fact: Trout will strike freely and well, it seems, at all times, on the fore-fin of a trout. Simply upon capturing a trout sever one of the fore-fins and attach it to the hook. Some of the largest rainbow trout in the mountains will take the fin viciously when even the succulent grasshopper fails. This fact may be known to some anglers, but it is as one in ten. The same is true of a little white strip cut from the belly of one of your trout, about two inches long and one-half inch wide at the butt end. Attach this to the hook at its tip and play it to the current. If the current is strong, one will need to place several split-shots on the leader to sink it. Then let out line. Let it flow downstream. Seventy-five, one hundred, one hundred and fifty feet, perhaps. Down it goes, moving in and out of the pools. Suddenly a large fellow beside a boulder will seize it and the fun begins. These methods win when the fish are weak on surface feeding, and are closer to the bottom; and this often happens. Do not forget the fore-fin or the belly-fin of the trout as a lure. Many are not aware of it, but the artificial fly known as the Parmachenee Belle, was made in imitation of the belly-fin of a trout. Think of it; instead of imitating an insect (as many suppose it should) it is an imitation of the belly-fin of a trout. Could anything be more incongruous? Yet it was such a valuable hint that the inventor (a great angler) made a fly to represent it. The July and August angler in the mountain pools should give this his careful attention.

It has been said that there are times in July and August when the angler is not able to "rise" a fish; that the fish do not even seem to do any surface-feeding. Naturally, the best fishing goes on when the fish are rising to the top for insects, as when a hatch of insects is on and they are rising from the bottom of the stream. The higher one goes up in the mountains the fewer, it appears, become the true stream insects. The angler must needs use art in collaboration with some true study to make some appreciable catches. Mountain trout may be uncertain fellows. Having had poor luck (if any) with a small fly, he may

shift to a rather large fly (even a bass fly) and immediately rise a large fellow and make the best catch of the season. The trouble with the ill-luck of many anglers is that they give no time to experimentation. They place their luck with one variety or color of fly, or one size of fly, and remain at that, without trying anything else. There is another extreme to this in that many fly-fishermen are constantly changing flies and using one but five minutes before another shift is made. The result is that no fly is given a true tryout. Again there is a hint learned from experience: One cast well-judged and well-placed is worth ten indifferent casts that have been poorly placed. The difference is that the well-placed cast is the one that brings success; the poor casts, ill-judged, are so much waste of time. Study every nook and cranny of the stream you are to cast over. Don't make a cast till you have mentally made note of where a large fellow would in all likelihood happen to be. For instance, beside that large boulder there is a patch of still water. If you can make a cast so that your fly, or flies, will fall on the boulder you will craftily pull them off the boulder—and in the most natural manner they will fall to the still patch of water. Deceived, believing the artificial flies true insects, that large and dazzling rainbow will rise and take the offering. Or here is a semidark place under a sedgy bank. There is a still place there. A trout should be lurking in that nook. Or here is a log in the water. Try your bait or fly alongside of that, seeing to, always, that your fly falls first, not the line and leader first. Poor casting, I firmly believe, has only one result, that being: Ill luck!

During the fore part of the season a great number of anglers go out, but they are live-bait users almost entirely. The salmon-egg contingent, the dyed-in-the-wool fly-fisherman calls them—and the true fly-fisherman can be counted on to eschew the streams till the inimitable July and August days arrive. Then he goes happily forth into the mountain stillnesses.

There is a reason, too. The early fisherman had to contend with high and swift water which was mostly discolored. It was the using of live bait entirely, for the stream insects were not hatching, so that the trout could be deceived by artificial counterparts. Now, however, the winged life is abroad; the fly-fisherman is in his element. As the warmer days come on, the water in the lower reaches of the rivers disappears or becomes heated out, the fish gradually but surely make for the upper pools, and thence follow the fly-fishermen. It is riotous travel at times; the road is rough. Sometimes there are no roads and one makes his own paths at will. But there is a reward among the cools of the upper valleys and natural parks where Nature in all her untrimmed and majestic glory contrives to make California the true Arcadia of the disciple of Walton.

PARASITES WHICH AFFECT THE FOOD VALUE OF RABBITS.

By E. RALPH DE ONG, University of California.

A fringe of small, lead-colored bodies, the size of coarse shot, is frequently seen on the ears of the brush or cottontail rabbits. These are young ticks, the immature form of one of our common species, probably the wood tick (*Dermacentor occidentalis*). After hatching from the egg the young ticks wait in the grass for a passing rabbit or other animal, attach themselves and feed for three or four days, drop to the ground and molt (shed their old skins), then await another chance to feed.

The presence of these ticks has no effect on the rabbit except a slight loss of blood and a temporary annoyance, and as this tick has not been

Fig. 48. A young blacktailed jackrabbit, an animal often discarded for food because of the presence of parasites. Photograph by J. Dixon. Neg. 290, Calif. Mus. Vert. Zool.

reported in California as a carrier of any disease it need not be considered as of any significance.

The species of fleas commonly found on rabbits in this state have not been reported as disease carriers so that the presence of these insects can also be disregarded.

One species of botfly (*Cuterebra* sp.) attacks rabbits very commonly. The larvae of this fly is almost black in the mature stage, about three-fourths of an inch long and covered with tiny spines. Brush rabbits taken in Sonoma County up to the last of July were commonly infested with this insect. After the first of August no larvæ were found, they apparently coming to maturity at this time. They then leave the host and bury themselves in the ground, emerging the following year as flies. The larvæ are found just beneath the skin along the back or breast.

The only outward indication of their presence is a slight enlargement at the affected point. No injury to the muscles was noted in any infested specimen, the body being apparently in a normal condition. Wounds of this kind may, however, become infected by bacteria or become infested with some of the flesh feeding flies and in this way produce large tumorous swellings. These latter attacks, when severe, may produce an emaciated condition of the animal which manifestly impairs the value of the carcass for food. But if the larvae are present on the body of the rabbit, without any outward or internal sign of disease there would seem no reason for discarding the same.

Rabbits are occasionally taken in this state which show the larval form of a common tapeworm (*Cœnurus serialis*) which, when eaten by the dog produces the adult tapeworm *Tænia serialis*.[1] The infestation in the rabbit appears as a transparent, bladder-like swelling which may be as large as a hen's egg or larger and is of frequent occurrance in jackrabbits, often spoken of by hunters as "boils." Scattered about on the inner surface of this bladder will be seen white dots about half the size of a pinhead. These are the undeveloped heads of tapeworms, each one of which is capable of developing into a mature tapeworm if taken into the body of a carnivorous animal in a living condition. Hence an animal eating an uncooked rabbit infested with one of these bladder worms will develop a typical case of tapeworm. Thorough cooking will kill the larval form so that the meat can be fed to animals without danger. But the uncooked carcass or viscera should not be fed to animals.

One specimen of brush rabbit had two infestations: one originating in the thigh had grown so large as to displace the muscles, the second formed a large swelling on the surface of the breast. Any infestation of this kind should be regarded with suspicion and the carcass burned or buried deeply so as to be out of reach of all carnivorous animals.

Domestic rabbits and probably the wild form are subject to a disease called *coccidiosis* resulting from the attack of a sporozoa (*Coccidium oviforme*). The symptoms are snuffles, running at the nose and diarrhoea. The inner walls of the intestines show reddened patches with more or less ulceration. The liver is enlarged and the interior has many small round abscesses filled with pus; as the disease progresses the carcass becomes emaciated. Animals affected with this disease should be considered as unfit for food.

An ear mite (*Otodectes cygnatis*) is mentioned by Professor Herms as sometimes being abundant enough to cause serious disease or death to domestic rabbits.

[1]Determination by Professor W. B. Herms.

OUT FISHIN'.

By Edward A. Guest.

A feller isn't thinkin' mean—out fishin';
His thoughts are mostly good and clean—out fishin';
He doesn't knock his fellow men,
Or harbor any grudges then;
A feller's at his finest when—out fishin'.

The rich are comrades to the poor—out fishin';
All brothers of a common lure—out fishin';
The urchin with the pin and string
Can chum with millionaire an' king;
Vain pride is a forgotten thing—out fishin'.

A feller gets a chance to dream—out fishin';
He learns the beauties of a stream—out fishin';
An' he can wash his soul in air
That ain't foul with selfish care,
And relish plain an' simple fare—out fishin'.

A feller has no time for hate—out fishin';
He ain't eager to be great—out fishin';
He ain't thinkin' thoughts of self,
Or goods stacked high upon a shelf,
But he's always just himself—out fishin'.

A feller's glad to be a friend—out fishin';
A helping hand he'll always lend—out fishin';
The brotherhood of rod an' line,
An' sky an' stream is always fine;
Men come real close to God's design—out fishin'

A feller isn't plottin' schemes—out fishin';
He's only busy with his dreams—out fishin';
His livery's a coat of tan;
His creed's to do the best he can;
A feller's always mostly man—out fishin'.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

July 15, 1919.

"There is nothing that attracts human nature more powerfully than the sport of tempting the unknown with a fishing line."—Henry Van Dyke.

VINDICATION.

Periodically, the state Fish and Game Commission is attacked by members of the legislature. Any state commission which has to do with the enforcement of law is subject to such attacks. In 1911 an investigation was ordered by the assembly. The investigating committee, however, gave a very favorable report as to the activities of the Commission. The 1919 assembly began an inquiry which also resulted in complete vindication for the Commission. We hope to publish in the next number the full report of the Committee on Governmental Efficiency and Economy to which a resolution by Assemblyman Eden was referred. While it would seem that the resolution was actuated by spite, the result has been very favorable to the Fish and Game Commission, for it has shown the people exactly where the Commission stands and has widely advertised the accomplishments of the past few years.

NATURE STUDY LIBRARIES TO BE FURNISHED SUMMER RESORTS.

Compact nature study libraries will be placed at those Tahoe resorts which are selected for the educational work of the Fish and Game Commission the coming summer. The libraries will include books on birds, mammals, wild flowers, trees and kindred subjects. Donated to the state by the California Nature Study League, they will be deposited with the Fish and Game Commission to be thus utilized in the commission's educational work. These libraries will be annually loaned to summer resorts in the future and probably represent only the beginning of a work which will eventually cover all the summer resorts of California. They are intended for use at that time when people, being on a vacation, are most receptive to studying intimately the miracles of nature. In ways such as this the Commission is applying the motto: "Conservation through education."

THE 1918 CATCH OF FISH.

Among the reports of this issue of CALIFORNIA FISH AND GAME is a complete statement of the fresh fish taken in California during the year 1918. In this statement there is included a record of fish taken in Mexican waters and brought into California through San Diego and San Pedro, but this is not included in the total for California.

The total catch of all varieties of fish in California for 1918 was 250,218,041 pounds. Compared with the 201,575,953 taken in 1917, this shows an increase of 48,642,088 pounds, or a trifle over 24 per cent. For a ready comparison of catches of the more important fish for 1917 and 1918, the following table is given:

	1917	1918
Albacore	30,556,243	7,263,895
Barracuda	2,965,368	3,885,691
Bonito	889.896	2,264,164
Halibut	3,585,666	2,837,987
Herring	7,435,997	7,938,280
Mackerel	3,345,563	4,005,906
Rock fish	6,255,380	6,281,425
Sole	8,728,429	7,027,767
Salmon	11,007,442	13,026,076
Sand dabs	2,631,862	1,751,609
Striped bass	1,095,856	1,407,841
Shad (buck and roe)	5,616,110	2,383,635
Sardine	104,103,331	157,652,811
Skipjack	———	3,023,847
Tuna	———	6,240,971
Yellowtail	2,887,413	11,658,259

The figure for the albacore catch of 1917 includes the bluefin and yellowfin tuna taken. In 1918 the albacore catch was very short and as bluefin and yellowfin tuna were more plentiful, a much larger number were taken and were for the first time separated from the albacore under the name "tuna." The tuna and albacore catch combined in 1918 was less than half the albacore catch of the previous year.

The sardine catch shows a phenomenal increase although southern California had a light run of sardines during the latter

Fig. 49. Four new fish hatcheries. Upper left, Ft. Seward Hatchery, Ft. Seward, California; upper right, Kaweah Experimental Hatchery, Kaweah River, Fresno County, Cal.; lower left, Clear Creek Hatchery, Westwood, Lassen County, Cal.; lower right, Domingo Springs Hatchery, Domingo Springs, Plumas County, Cal.

part of 1918. Shad, halibut, sole and sand dab all show a decreased catch during 1918, while bonito, barracuda, mackerel, salmon, striped bass, skipjack and yellowtail all show an increased catch. Although the catch of salmon on Monterey Bay was less, much heavier catches were made at Drakes Bay Fort Bragg and on the lower Sacramento River, which brought the total catch for 1918 to over two million pounds more than that of the year 1917. There was no great fluctuation in the catch of other species.

There was a decrease of 41,177 dozen in the catch of crabs and of 41,943 pounds in the catch of crawfish, while the catch of shrimps shows an increase of 117,174 pounds ove the year 1917. The mollusks do not show any great changes over previous years.

The Department of Commercial Fisheries is making every effort to secure and complete accurate statistics of the catches of all fish and it can readily be seen that a comparison of yearly catches for a number of years will aid in determining whether any certain species is being overfished and depleted, or whether it is becoming more abundant.—N. B. S.

MAINTAIN A SUPPLY!

It can not be expected that wild life resources, if left to themselves, will continue to yield food and sport indefinitely. The reason, of course, is to be found in the encroachment of civilized man, which not only means increased destruction, but a diminution of food supply and nesting sites. Under the artificial conditions now fostered a constant supply can be maintained only through carefully planned protection and propagation. By looking over the attainments of the Commission whose function is to perpetuate fish and game, we are assured that the financial outlay has been more than justified.

RAINBOW TROUT ACCLIMATIZED IN ARGENTINA.

In 1903 at the request of the government of Argentina the United States Bureau of Fisheries donated the eggs of

several varieties of fish to the southern republic. A letter recently received by the Bureau states that thousands of Eastern brook trout are now being caught annually, that some measure 19 inches, and have a weight of 10 pounds. In the mountain range of Aconquija in 27° south latitude and in the Patagonian region as far south as 52° latitude, the rainbow trout is doing well.

A COLLEGE OF FISHERIES ESTABLISHED.

An event of great importance to those interested in the fisheries of the United States, and especially so to those of the Pacific coast, has been the recent establishment of a College of Fisheries in connection with the University of Washington at Seattle. The need for such a college has been felt for some time, and Dr. Suzzallo, the able and progressive head of the university, is to be congratulated upon his action in this matter.

The commercial fisheries of the Pacific coast are of great importance to its welfare, how much so being plainly indicated when it is stated that Washington, Alaska, Oregon, California and Hawaii produced last year approximately 1,600,000,000 pounds of raw fishery products valued to the fishermen at about $25,000,000. Seven-eighths of the world's pack of canned salmon is made on the coast, while tuna, sardines, clams, crabs, shrimp, mackerel, abalone, etc., are canned in large quantities and shipped to all quarters of the globe. Immense quantities of frozen, fresh, pickled, salted and smoked fishery products are also prepared and shipped. When so prepared the value of the fishery products of this coast alone is increased to over $100,000,000; the investment in plants, vessels, boats, fishing gear, etc., on this coast amounts to about $95,000,000, while over 75,000 persons are employed in fishing and preparing the above products for market.

The production of raw fishery products elsewhere in the United States amounts annually to approximately 2,250,000,000 pounds, valued, to the fishermen, at approximately $60,000,000. When prepared for market these products would probably be worth approximately $120,000,000.

The College of Fisheries just established by the university enjoys the distinction of being the only one of any consequence in the world outside of Japan. In the latter country the Imperial Fisheries Institute at Tokio is a government institution and has been in existence since 1897. Since then subsidiary schools have been established in various provinces of Japan.

Seattle is an ideal location for such a college, as within its corporate limits, or in territory immediately adjacent, are to be found in active operation practically every style of plant used in turning the raw fishery products into all forms of manufactured articles both for food and for use in the arts and sciences; while the great salmon, halibut, cod, and herring fleets operating in Alaska waters have their headquarters mainly in this city, outfitting here and bringing back the products for shipment to the four corners of the world.

The college offers four year courses in fisheries technology and fish culture. The fisheries technology courses will train men

TROUT FRY DISTRIBUTED IN STREAMS AND LAKES OF CALIFORNIA DURING PAST THREE YEARS.

	1916	1917	1918	Total
Rainbow	3,399,920	5,223,500	5,680,500	14,303,920
Eastern brook	2,068,500	1,617,500	2,294,500	5,980,500
Loch Leven	1,620,000	1,468,000	1,633,000	4,721,000
Black spotted	3,835,270	3,836,000	1,059,500	8,730,770
Steelhead	5,213,170	6,699,420	4,483,000	16,395,590
German brown	77,300			77,300
Golden trout			384,000	384,000
Totals	16,214,160	18,844,420	15,534,500	50,593,080

for various lines of work in industrial plants. Owing to the immensity of the business, as noted above, there is always a demand for trained men in the salmon and other canneries cold storage plants, smokehouses, and fertilizer and oil plants. Every effort will be made to make the courses as practical as possible, and students will make visits to the plants whenever possible so they may obtain first-hand information as to the methods in vogue. They will also receive training in bacteriology and chemistry, and thus will be fitted for work in marine biological laboratories, and in chemical and bacteriological laboratories, specializing in fishery products.

The practice of fish culture is becoming a very important one, and the demand for trained men is bound to increase. Students at the college will not only have the benefit of its instruction and equipment, but can also obtain an abundance of practical experience along all lines of fish culture at the many federal and state hatcheries scattered throughout the state of Washington.

Pond culture, or the farming of our inland waters, will some day be an important industry, as there are many thousands of small lakes, ponds, streams, and marshy spots which would be utilized in this work, and acre for acre produce greater returns than a similar area of land devoted to agriculture.

The shellfish industry of the Pacific coast has not thrived for some years, due largely to faulty methods, and it is hoped that with more modern methods taught there may be a revival of this industry, which ought today to be one of the most important on the coast.

It is hoped in the near future to offer short courses in practical fishery subjects during the winter months when fishing operations are quite generally suspended, these courses to be open to those now engaged in the fisheries and others who desire knowledge along special lines and do not have the time nor desire to take the full courses.

As the university is a state institution, an especially important part of the work of the College of Fisheries will be in rendering assistance and advice whenever called upon by the state authorities, and also to aid the commercial fishermen not only of the state but of the nation in solving the many problems which beset them, and to aid in the conservation and perpetuation of our wonderful fishery resources. Research work along the lines of utilization of hitherto neglected species, and of waste products, will be carried on and it is hoped will result in materially increasing the wealth of the state and nation.

It had originally been planned to open the college at the beginning of the fall term in October, but so many of our returning soldiers expressed a desire to take up the work at once that hurried preparations were made and the college opened for the spring quarter beginning March 31, last.—JOHN N. COBB.

MANY LIONS KILLED.

Bounty reports for the first three months in 1919 show that an unusually large number of mountain lions have been killed in the state. The exact reason for this kill is not apparent, but doubtless the hiring of a man to give all of his time to the destruction of predatory mammals has had some effect in stimulating the destruction of the famous deer killer. The totals for the three months are as follows:

January.		
21 males	at $20.00	$420 00
24 females	at $30.00	720 00
		$1140 00
February.		
10 males	at $20.00	$200 00
16 females	at $30.00	480 00
		$680 00
March.		
22 males	at $20.00	$440 00
18 females	at $30.00	540 00
		$980 00

AIRPLANES TO LOCATE FISH.

Still another use for the airplane is to be found in the recent experiments carried on along the Atlantic coast where a duly qualified observer has been making flights to locate schools of fish. Information so obtained is telegraphed to the fishing interests.

FISHERY PRODUCTS LABORATORY ESTABLISHED.

The increased importance of the California fisheries has led the United States Bureau of Fisheries to establish an experimental laboratory at San Pedro. The laboratory is now completed and the equipment installed. A corps of three scientists will experiment on methods of preserving fish and otherwise render service to those engaged in canning, drying or salting fish.

THE OWNERSHIP OF WILD LIFE.

Wild life is the property of all the people. No one attempts to deny this, and least of all the game violator. From his point of view it is not only the property of all the people, but it is more particularly the property of him who can get it. The more remote the locality where the law is violated, the more deeply rooted is the idea that the game is there to be taken, regardless of law, and without much feeling of moral obliquity. The violator has a strange feeling that some sort of justification is on his side, though the law may be on the other. The point of view is that of early colonial times, before the state had reason to assert its ownership—when, indeed, game was the property of anyone who could shoot straight enough. It is the point of view of an extreme individualist.

Game is still the property of everyone. But, whereas originally the people placed no restrictions upon the use of that property, they have now thrown about it safeguards that are vital for its continued existence. Every citizen has a vested interest in every individual bird animal and fish, and is defrauded if the game is taken in any way contrary to the established rules. The point of view of the man who respects the law, and insists upon respect for it in others, is that of collective ownership. His individual right to take game is dependent upon consent to do so from others.

The feeling of collective ownership is still only partly developed. The tendency to wink at violations still decreases as the sense of common ownership of wild life is strengthened.—*The Conservationist*, Nov. 1918, p. 173.

OUR FUR RESOURCES.

More and more we are discovering that the annual take of furs in California is considerable and that the money received by the trappers amounts to a large sum. Most of the furs are shipped to Eastern markets, but recently it has come to our notice that many furs are utilized by the trappers themselves. The books of the Eberhard Tanning Company of Santa Clara showed that during 1918 the following skins were tanned by them: 11 bear, 7 lion, 488 deer, 128 coyote, 86 raccoon, 12 badger, 176 fox, 15 opossum, 95 skunk, 121 wildcat, 429 rabbit, 53 tree squirrel, 14 mole.

A canvass of the different tanneries would doubtless furnish some valuable evidence as to what proportion of furs are used for home consumption.—I. L. KOPPEL.

BLACK BASS IS NOT A TRUE BASS.

Some of our readers have perhaps wondered why they did not find some mention of the black bass in the article entitled "Bass and Bass-like Fishes" which appeared in the April number. The primary reason is that the black bass is an introduced fish in our state and furthermore, this fish is more closely related to the sunfishes than to the true basses.

FACTS OF CURRENT INTEREST.

J. C. Bruce, the state lion hunter, has been at work in and around the McCloud River Game Refuge, District 1E. In this locality he secured three lions. This makes a total of 15 since January 1, together with 6 wildcats. Mr. Bruce started operations in Monterey County during May.

The past year brought splendid returns to the fur trapper. In several instances trappers received as high as $20 for coyotes, $8 for wildcats, and $2.50 for muskrats.

The Fish and Game Commission will install a permanent exhibit in the new building at the State Fair Grounds in Sacramento. The whole north alcove will be used to display the fish and game of the state and the activities initiated to conserve it.

Motion pictures showing the commercial fisheries of the state are being secured for use in educational and publicity work.

Far more definite research work on fish and game is now being carried on by the Commission than has been undertaken heretofore. Professor J. O. Snyder of Leland Stanford Junior University has been secured to undertake a scientific investigation of the quinnat salmon.

A study of the furbearers and the furbearing resources of the state is being undertaken by the Commission.

One haul of a trawl net made recently off the coast of southern California netted a ton of fish of seven different varieties.

Sportsmen convinced that the deer season has opened too early in southern California succeeded in having the law changed by the Legislature to provide for a September 15 opening, 15 days later than formerly.

Applications have been received requesting the setting aside of three different areas as state game reservations. An area of 25,000 acres, one of 30,000 and one of 20,000, are situated in Santa Barbara and Ventura counties.

Progress is being made on the attempt to negotiate treaties with the Spanish-American republics for the protection of migratory birds. The matter has been referred to the Department of Agriculture that appropriate conventions may be drafted. The state department has promised to act as soon as these drafts are received.

Paladini, the wholesale fisherman of San Francisco, was recently arrested for trawling within the three mile limit. He deposited $250 cash bail for his appearance before Judge De La Montanya at San Rafael. As Mr. Paladini did not appear, his bail was declared forfeited and a bench warrant was issued and given to Constable Crane to serve.

HATCHERY NOTES.

W. H. Shebley, Editor.

BROOKDALE HATCHERY.

The take of eggs at the Scott Creek station will amount to approximately 1,700,000, of which 1,000,000 will be hatched at the Brookdale Hatchery for distribution in the streams in that section of the state. Shipments of eggs have been made to Wawona, Mt. Shasta and Mt. Whitney hatcheries, from which stations they will be given general distribution in suitable streams.

SNOW MOUNTAIN STATION.

The take of eggs at Snow Mountain Station, on the Eel River, was much greater than that at Brookdale, and will amount to probably 4,500,000. Of the eggs hatched at Snow Mountain 200,000 are to be planted in the upper reaches of the Eel River near the station, and the balance of the eggs have been shipped to Ukiah, Yosemite, Fort Seward, Mt. Whitney, Domingo Springs, Mt. Shasta, Kaweah and San Mateo hatcheries. From these stations the resulting steelhead trout fry will be given an extensive distribution under the arrangements made for carrying on this season's operations.

MT. TALLAC HATCHERY.

The Mt. Tallac Hatchery was opened for operations during the latter part of March, and the work is progressing very nicely. To date there have been nearly 2,000,000 black-spotted trout eggs taken and we expect to reach the 3,000,000 mark before the end of the season.

FALL CREEK HATCHERY.

The rainbow egg-collecting stations on the Klamath River were opened for operations during the month of February. Racks and traps were installed in Cottonwood Creek, near Hornbrook, and in Camp, Bogus and Fall creeks; and 1,750,000 rainbow trout eggs were taken at the four stations. A portion of the eggs were immediately shipped to Mt. Shasta Hatchery to be eyed, and the balance were placed in troughs at the new Fall Creek Hatchery, where they will be eyed for shipment to stations in other parts of the state. We have also arranged to hatch nearly a half million rainbow eggs at the Fall Creek Hatchery for distribution in the Klamath River this season. A million quinnat salmon eggs

Fig. 50. Fall Creek Hatchery. A fine modern hatchery built by the California-Oregon Power Company in lieu of a fishway over the Copco Dam. Photograph by L. J. Stinnett.

have also been hatched at the Fall Creek Hatchery and the resulting fry will be distributed in the Klamath River. Shipments of rainbow eggs will be made from Fall Creek Hatchery to Ft. Seward, Mt. Shasta and Yosemite hatcheries, from which stations they will be given the usual distribution.

BEAR LAKE HATCHERY.

Fish cultural operations were commenced at the North Creek egg collecting station during the latter part of March and racks were put in both North Creek and Metcalf Creek. The season has been a very favorable one, and while the run is still on, we believe that the take of rainbow trout eggs at this station will amount to approximately 4,500,000. Arrangements are being made to hatch and distribute 750,000 rainbow fry from the North Creek Hatchery, and a like number will be sent to the Bear Lake Hatchery, located at Green Spot Springs, from which station they will be distributed in Big Bear Lake and streams of San Bernardino County later in the season. Arrangements are being made to ship eyed eggs from the North Creek station to Mt. Whitney, Mt. Shasta, Yosemite, Kaweah and Wawona hatcheries.

ALMANOR HATCHERY.

Almanor Hatchery was opened for operations during the early part of March, and during the fore part of the season there was a good run of rainbow trout. However, it became necessary for the Great Western Power Company to run a big head of water through the Almanor spillway on account of the rapidly melting snow, and this prevented the biggest part of the run of rainbow trout from reaching our racks. However, we will probably receive between 300,000 and 400,000 eggs as the result of the season's work.

DOMINGO SPRINGS HATCHERY.

Domingo Springs Hatchery was opened the latter part of March and at the present time the run of rainbow trout in Rice Creek is on. Very few eggs have been taken to date, but the season promises to be a very favorable one.

CLEAR CREEK HATCHERY.

Clear Creek Hatchery will be opened up during the latter part of May and rainbow trout eggs will be shipped to this station from Almanor and Domingo Springs hatcheries. The resulting fry will be distributed in streams in the vicinity of Westwood and other portions of Lassen and Plumas counties.

MT. SHASTA HATCHERY.

The take of Loch Leven and German brown trout eggs was very successful. More Loch Leven trout fry will be distributed from Mt. Shasta Hatchery during the coming season than ever before. The German brown trout eggs taken are from stock held in the ponds at Sisson Hatchery resulting from eggs received from the Minnesota Fish and Game Commission three years ago. These will be the first German brown trout fry distributed in California for a number of years. The take of Eastern brook eggs was less than usual, and we will have only approximately 1,000,000 fry of this species for distribution during the coming season. Rainbow trout eggs from the Klamath River stations, Domingo Springs and North Creek, and steelhead eggs from Brookdale and Snow Mountain stations have been shipped to the Mt. Shasta Hatchery and the same will be hatched and reared for distribution in streams.

MT. WHITNEY HATCHERY.

Rainbow, Loch Leven, Eastern brook, black-spotted and steelhead eggs have been shipped to Mt. Whitney Hatchery from different stations in the state, and the resulting fry will be given wide distribution in the streams of southern California during the coming season. During the coming month we expect to open up Cottonwood Lake station, and if results are as satisfactory as during the past season we should obtain a half million or more golden trout eggs. These would be immediately transported to Mt. Whitney Hatchery and hatched for distribution in streams and lakes of the state.

WAWONA HATCHERY.

Wawona Hatchery was opened shortly after the first of May and rainbow and steelhead eggs are being forwarded from other stations. The resulting fry will be given the usual distribution in that section.

Fig. 51. Bear Lake Hatchery, San Bernardino County, California. The output of this hatchery stocks most of the streams of southern California. Photograph by Berry.

EXPERIMENTAL HATCHERIES.

A hatchery has been established in the Yosemite Valley at a site selected for the erection of a permanent hatchery, if the results of this season's operations are satisfactory. Before erecting a permanent hatchery in this section we deemed it advisable to determine by practical experiments if conditions were favorable for fish cultural operations. Rainbow, steelhead and black-spotted trout eggs will be shipped to the station and if the experiments are successful the resulting fry will be distributed in streams and lakes of the Yosemite Valley.

An experimental hatchery to determine the suitability of the waters of the Kaweah River for hatchery purposes has been established on the Kaweah River, near the town of Hammond, Tulare County. Rainbow, steelhead and black-spotted eggs have been shipped to this station, and if the resulting fry survive they will be distributed in the waters tributary to the Kaweah River, Tulare County.

NEW EXPERIMENT ON HATCHING SALMON ARTIFICIALLY.

The California Fish and Game Commission is trying out a series of experiments with trout eggs, to determine whether or not salmon can economically and scientifically be hatched and reared in cages placed in the beds of streams. These experiments will be conducted with eggs artificially fertilized and placed in the beds at different stages of development. Later in the season when salmon eggs are available the experiment will be continued by substituting the salmon for trout eggs. The idea is not a new one, as it was suggested by Professor Cloudsley Rutter in 1899. An experiment was made by Professor Rutter at that time, but on account of an accident the result was not conclusive. The Commission will now carry on experiments to determine whether any improvement in the propagation of salmon can be made along these lines. The experiments will be under the supervision of the fish experts of the Department of Fish Culture.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

FRESH FISH USED BY REDUCTION PLANTS AT SAN PEDRO.

During the last four months millions of pounds of fresh fish have been used in the manufacture of fish meal and fertilizer. The run of fish increased to such an extent in the first part of May that the reduction plants could not handle all the fish brought in. The fishermen, however, continued to bring in large catches of sardines regardless of any idea that they could be disposed of or handled by the reduction plants.

On April 30, the Minnie F brought in 58,995 pounds of barracuda, all of which could not even be used by the reduction plants.

The total amount of fish used to manufacture fish meal and fertilizer during the months of January, February, March and April, 1919, was as follows:

	Pounds.
Sardines	15,630,067
Barracuda	58,995
Rock cod	15,254
Kingfish	9,290
Halibut	4,400
Shark	2,712
Total	15,718,006

Fig. 52. Boatloads of sardines at San Pedro, May 6, 1919. All of this fish went to the reduction works to be made into fertilizer.

went to a reduction plant. On May 6 many sardine boats arrived loaded to full capacity with sardines which later went to reduction plants to be made into fish meal. One of these boats had 26 tons of sardines on board.

All the reduction plants combined have a capacity of about 1200 tons daily. The surplus was so great the city health department ordered 185 tons of sardines dumped out at sea in one day. The sardines were in such a bad condition they

Up to June 1, over 32,000,000 pounds of sardines had been utilized by the reduction works.—Earl M. Nielsen.

BETTER RECORDS OF CATCH NECESSARY.

In this issue of California Fish and Game will be found a statement of the canned, cured and manufactured fishery products of California for the year 1918. Although most of the packers have gladly furnished the Commission with the infor-

mation requested, considerable difficulty has been experienced in securing the record of packs made by a few firms throughout the state. Because of the lack of co-operation on the part of these few firms there are, no doubt, a number of discrepancies in the figures, not so much in the quantity as in the size and kind of container. Much of the salt fish is shown in barrels, although much of it may have been packed in smaller containers. The tuna pack reported by some firms includes

Fig. 53. Food fish made into fertilizer. Left, 26 tons of sardines; right 58,000 lbs. of barracuda.

their albacore pack, therefore the tuna pack shown is really more than the actual pack, while the albacore pack is short.

It will be the aim of the Commission to have the necessary blanks for the 1919 pack in the hands of all packers before the end of the year and it is hoped that all packers will co-operate with the Department of Commercial Fisheries of the Fish and Game Commission by filing a complete and accurate report of their operations for 1919 at the close of the year. This will enable the Commission to issue intelligent information on the California industry which should be of great value to all concerned. No information is given out regarding the pack of any individual firm and any statement or report made up and published, or furnished for publication, will be for the sole purpose of furthering and boosting a great California industry.

FIRST TUNA RECEIVED MAY 14.

The first yellow-finned tuna to reach any of the San Pedro and Long Beach canneries was received by the Van Camp Sea Food Company on May 14. The tender Undine brought approximately 13½ tons of yellow-finned tuna (*Thunnus macropterus*) from Lower California, where the above company is operating a cold storage barge and floating cannery in conjunction with its San Pedro plant.

NORTHERN BOATS JOIN FISHING FLEET.

Eleven purse seine boats have arrived at San Pedro harbor from Puget Sound points. These boats average from 60 to 65 feet in length and are equipped with heavy duty engines of from 45 to 85 horsepower. They were formerly engaged in salmon fishing, but plan to fish for tuna in southern California waters.

FISHERMEN RECEIVE 20 CENTS FOR FIRST TUNA.

The first tuna (*Thunnus thynnus*) to reach the local wholesale markets were brought in by the Peter Pan, a purse seine boat, on May 22. The total catch consisted of 3717 pounds and the fish averaged about 20 pounds each. The fishermen found an active market for their catch and received 20 cents per pound in the round.

FLOATING CANNERY BURNS.

The floating fish cannery, John G. North, which before its conversion was a sailing vessel, plying between Honolulu and San Francisco and other Pacific coast ports, was burned to the water's edge the morning of May 14 off Cape San Lucas on the coast of Lower California, according to word brought here by the fishing launch Rex. The John G. North was beached, all the crew reaching the shore safely. The loss was $50,000. The John G. North was operated by the Van Camp Sea Products Company, which has a plant at San Pedro.

NOTES FROM THE STATE FISHERIES LABORATORY.*

By Will F. Thompson and Elmer Higgins.

GOAT FISH TAKEN IN CALIFORNIA.

Several specimens of a rare and beautiful fish hitherto unknown in southern California waters were taken by the Albacore in March, 1919. They belong to the species *Upeneus dentatus*, of the family of surmullets. The fish are small, covered with large scales, and brilliantly marked with crimson and yellow bands. A pair of long fleshy barbels extending backward from the point of the chin makes the name of "goat fish" seem appropriate.

The species is recorded as "rare" on the coast of Mexico, and has been taken only at Cape San Lucas, La Paz and Tres Marias Islands at the far end of Lower California. The specimens taken by the Albacore are from Encinitas in 21 fathoms and from Long Beach in 5 fathoms.

This is another instance of a supposedly rare fish taken by new methods of fishing. The error in assuming that such rare fish are migrants from Mexican waters, where they are abundant, is apparent.—E. H.

SPINY LOBSTER LARVÆ.

An interesting addition to our knowledge of the life of the spiny lobster provided by the collections of the Albacore, is another series of larvæ in the phyllosome stage. These specimens are similar to the ones described and figured for the first time in the January number of California Fish and Game and although they were taken in February, six months later than the first series, they show about the same degree of development. About two dozen were taken in surface nets in the vicinity of Osborn bank, outer Santa Barbara passage.—E. H.

ATTEMPT TO REAR GRUNION.

Following the discovery of the remarkable spawning habits of the grunion or little smelt (*Leuresthes tenuis*), the story of which by Will F. Thompson has just been published as Fish Bulletin No. 3, an attempt was made in a small way to rear the young grunion through the larval stages to the adult condition. The young were hatched from eggs taken from the beach and were placed in jars of sea water. Running water was not used, but the water was changed daily and food was added daily from tow-net collections taken from the end of the Long Beach pier.

The larvæ lived thus at about room temperature with a maximum range of 10° F. for eleven days, when the last one died. The fish, of course, had not lost their larval character in this time, but interesting and valuable observations were made on their early development, and on their food and feeding habits. The experiment also yielded experience which will be valuable in the rearing of the young of other food fishes—an undertaking which may be carried out with adequate equipment in the new laboratory.—E. H.

*California State Fisheries Laboratory, Contribution No. 9.

LIFE HISTORY OF FLAT-FISH.

The investigation of the life histories of various flat-fishes of southern California has been progressing satisfactorily. Fourteen species of flat-fish, Pleuronectidæ and Soleidæ, have been taken to date by the bottom nets of the Albacore and notes on their distribution and movements recorded. Material for the study of the development of several species has also been taken and is awaiting careful study. Among this material is a complete series in the development of the sand dab from the youngest larva scarcely 5 mm. long to the spawning adult. Very young stages or partial series have also been taken of the big-mouthed flounder (*Hippoglossina stomata*), the sharp-ridged flounder or turbot (*Pleuronichthys verticalis*), the lemon sole (*Parophrys vetulus*), the long-finned flounder (*Xystreurys liolepis*), two species of sand dab (*Citharichthys stigmaeus* and *C. xanthostigma*), the diamond flounder (*Hysopsetta guttulata*), the tongue sole or San Diego sole (*Symphurus atricaudus*), and the California halibut (*Paralichthys californicus*).

The study of the California halibut has proceeded further than the rest and includes observations on the age and rate of growth, comparative sizes and numbers of the sexes, seasonal movements and migrations between banks, spawning period and egg-production, and early development.—E. H.

PORPOISE CAPTURED.

A unique experience in shooting big game was enjoyed by the naturalist aboard the Albacore when he killed a large porpoise, probably of the species *Lagenorhynchus obliquidens*, on April 19, 1919.

A school of about a dozen individuals was sighted about 35 miles west of Point Vicenti cruising on a course diagonal to that of the launch but at such speed that the launch was soon overtaken. The porpoises paused, circled about the boat several times, leaping and playing, and then resumed their original course. A lucky shot from a high powered rifle, however, caught one of the big fellows fairly in the body as he was leaping, and the rest vanished instantly. Death, which came after only a hundred yards or so of mad leaps and plunges, left the animal floating, head up, when he was easily gaffed and hauled on board with block and tackle.

The specimen was an adult male seven and one-half feet long and weighed about four hundred pounds. The skin was black on the back, head, and fins, white on the sides and belly and of satin smoothness without signs of bristles or hair as might have been expected, the porpoise being a mammal and not a fish. The skin was uniformly underlaid with a layer of dense hard blubber fully one inch in thickness, as was discovered when the animal was butchered.

Although the mouth is small and practicaly toothless, the porpoise is evidently a carnivorous animal, as the cardiac stomach contained six recently swallowed sardines of unusually large size—about one foot in length. In addition, the stomach contained about a pint of partially digested material and a quantity of fish scales.

The flesh of the porpoise is very tender, resembling beef in texture but is very dark in color. The flavor is delicate but quite different from any other meat. The body is so thick that the tenderloin supplied a great number of steaks and pot roasts of excellent quality except for the lack of streaks of fat so desirable in beef. The liver was large, closely resembling that of pork liver in flavor, and the heart baked *en casserole* was indistinguishable from that of beef. On the whole, the porpoise would be a valuable food animal if the public palate could be educated to the unusual.—E. H.

HALIBUT EATS LARGE ROCK.

The gray cods are famous all the world over for taking into their stomachs what the fishermen term "ballast," in the shape of stones of various sizes. These are considered necessary to enable the cod to maintain an even keel during the storms which rage on the surface of the sea above them. But it is not as generally known that the halibut (*Hippoglossus*) does the same thing. Due to the kindness of Dr. F. Kermode, director of the Provincial Museum at Victoria, B. C., I am able to reproduce the following letter from a prominent fisherman of Vancouver, B. C.:

"Mr. Walter White, for many years employed as a halibut fisherman on the vessels of this company, and latterly as a mate on our S. S. Kingsway, brought to the office this morning a rock weighing about two and a half pounds. White states that he personally took this rock from the stomach of a halibut weighing about 60 pounds, during August, 1918. The S. S. Kingsway was fishing off Bonilla Island at the time, in thirty-five fathoms of water."

The explanation of this lies in the fact that the halibut are famous eaters of small things as well as large things, and they pick from the ground and from the rocks and kelp all sorts of animals, including sea anemones, clam siphons, worms, etc., and in the process of doing so they frequently take in things which were not intended to find a lodging in the stomach of a fish. It is due to reckless eating, not to foresight in taking in "ballast."—W. F. T.

YOUNG OF THE LADYFISH DISCOVERED.

In the April, 1919, issue of CALIFORNIA FISH AND GAME note was made of the abundance of the young of a supposedly rare species, the so-called "king of the salmon." We have another similar case to record here, the young of the ladyfish, *Albula vulpes*, having been taken in numbers in several hauls of a bottom net by our boat, the Albacore. The adult fish is classed as a rarity in the markets, though specimens are usually carefully saved, but the finding of many young indicates that the appearance of scarcity is rather a result of the failure of present modes of fishing to take the adults except as an accident.

The young here mentioned were taken three hundred yards off American avenue, in Long Beach, in from four to five and a half fathoms. They are approximately 7 centimeters (2¾ inches) in length, very transparent and delicate.—W. F. T.

CLAM INVESTIGATION.

The Fish and Game Commission has been fortunate enough to secure the services of Professor Frank W. Weymouth of Stanford University for a short period, beginning April 20 and ending in June. He will be remembered as having done much work on the edible crab (*Cancer magister*) of the Pacific coast. Professor Weymouth will initiate work on the clams of the coast which will prove of general interest, it is believed. The laboratory at Long Beach will be his headquarters.—W. F. T.

SHAD CAUGHT AT SEAL BEACH.

On the twenty-second of April of this year there was what might be termed a "run" of shad, *Alosa sapidissima*, several hundred pounds being brought in on that and succeeding days. They were taken in sardine nets, one of the hauls being taken off Seal Beach. All the fish were of large size.

The occurrence of the shad in the waters of southern California is rather unusual, although several times recorded as far south as San Diego. We are under obligations to Mr. Neilsen of the San Pedro office of the Commission for information concerning the run.—W. F. T.

ALASKA BLACK COD TAKEN NEAR SAN PEDRO.

A specimen of the Alaska black cod (*Anoplopoma fimbria*), 5½ inches long, was taken April 20, 1919, near San Pedro by a sardine fisherman. It has been previously recorded from off Point Loma, near San Diego, by Starks and Morris. It was not recognized by any fisherman in San Pedro, and is apparently a very rare species. Mr. Neilsen of the San Pedro office obtained the specimen for us.—W. F. T.

CANNERY RECEIVES MEXICAN FISH.

There have been several species of Mexican fish brought recently to San Pedro by the Van Camp Sea Food Company. They were obtained near Cape San Lucas by fishermen working for the floating cannery (lately destroyed by fire) belonging to that company, and are noteworthy as perhaps the first fish brought in a fresh condition from so far south. They included the following species:

1. *Caraux hippos*, the "toro," a very dark-meated fish allied to the pompanos and yellowtails.

2. *Neomaenis* sp., the "red snapper," a species closely allied to the snapper of the Gulf States, and hence probably of considerable commercial value.

3. *Xesurus punctatus*, the "cochinito," not generally regarded as of use commercially.

4. *Nematistius pectoralis*, the "pez de gallo," or "rooster-fish," a large fish with long dorsal spines, perhaps nearest to the yellowtail (*Seriola*) but dark meated.

5. *Trachinotus rhodopus*, the "pampanito," a pompano of good eating qualities.—W. F. T.

THE BREEDING SEASON OF THE SARDINE.

In view of the general interest in the habits of the sardine, the following general summary of work on its breeding season is presented:

During the years 1917 and 1918, careful examinations of the sardine were made at intervals to observe the state of the roe. As the summer approached, the examinations were made at more frequent intervals. The net result was to prove that throughout January, February, March, and April the ova increased steadily in average size, but that during May the fish which could be termed mature disappeared in large part.

Later, toward the end of May, there appeared what seemed mature fish with spent and regenerating roe sacks. These were, however, in small numbers and had to be carefully culled from the great numbers of small fish brought in. The fair presumption was that the mature sardines had become inaccessible to the fishermen, either through a seaward migration or a change in habit. No spawning sardines were taken at any time.

The discovery of what appeared to be spent fish in small numbers did not, however, prove that the spawning season had passed, or even that it was well under way. That a certain proportion of most species spawn early, and that there is a period when the spawning is at its height, with a following decline, seems probable. If the sardine is such a species, the finding of spent fish merely means the initiation of the spawning period. That this is probably true would appear from the fact that the roe in no case examined was so close to a spawning condition as to justify a belief that it was distant less than a month.

These facts have been entirely corroborated during the spring season of 1919. A series of samples have been collected and examined daily since the early part of May until the date of writing (May 26), and the same succession of changes have been observed.

The young of the sardine under 30 millimeters in length have been taken in the fine meshed nets of the Albacore during the winter months. Pending a careful examination of these younger forms, it is not attempted to decide the time of the spawning season. The only justified conclusion is that spawning fish are not taken in any numbers by the fishermen.—W. F. T.

CONSERVATION IN OTHER STATES.

REFORMS IN NOVA SCOTIA FISHERY SERVICE.

Four years ago there was hardly a river in Cape Breton Nova Scotia, where trout and salmon were not illegally taken with spear or net every year, and in many streams the fishing had been almost completely destroyed. All of the guardians were political appointees; all were poorly paid, and at least three-fourths were neglectful or inefficient. In July, 1914, the Victoria Fisheries Protective Association was organized, and in the fall of that year its officers made an exhaustive report of 12,000 words to the Minister of Marine and Fisheries of the state of the rivers in Cape Breton Island, and the urgent need of reorganization and reform in the fishery service. In this report, which was accompanied by abundant proof in the shape of six or eight voluminous exhibits, the association pointed out the evils of political control; asked for twelve special guardians with increased salaries; suggested that the number of fishery officers in Cape Breton be reduced from 233 to 50 by the dropping of political workers from the rolls, and recommended that in future all guardians be liberally paid and be appointed for merit only, regardless of political influences.

Nearly all of the recommendations have been adopted. The number of fishery guardians has been reduced from 219 to

44; salaries have been more than doubled; the fishery service has been taken out of politics, and the appointment of all guardians has been entrusted to the Civil Service Commission in Ottawa. Guardians hereafter will be selected for merit only; they will do no political work, and they will devote all of their time to an effective patrol of the streams. Thus, for the first time in more than a generation, the fishery service of Cape Breton Island has been put on a business basis. We now have sixteen head guardians with a salary of $70 a month each, and twenty-eight subordinate guardians with a monthly salary of $25 each. The cost of the guardian service is about the same as it was under the old system, namely $10,400 a year; but the government is now paying that sum to forty-eight guardians instead of distributing it among 219.

STURGEON TO BE PROTECTED IN OTHER STATES.

Several years ago it was found necessary to give the sturgeon total protection in California. Other states now realize that this splendid food fish is almost exterminated and are planning to enact protective legislation. So depleted is the supply in Lake Erie and neighboring waters that Ohio, Pennsylvania, New York, and Canada all propose to protect lake sturgeon for a three-year period beginning in 1919. Although once so common that they formed cheap food for the common people, lake sturgeon are now so scarce that only the wealthy can utilize them. Recently sturgeon have been selling up to 45 cents per pound in the New York market.

LIFE HISTORY NOTES.

NESTING OF THE BAND-TAILED PIGEON.

From an old data book of mine I am able to give the following details of the nesting of the band-tailed pigeon (*Columba fasciata*). The record shows that I discovered a nest at the head of the Lopez Canyon, about ten miles east of San Luis Obispo, in San Luis Obispo County, California, on March 30, 1895. The nest, a flimsy affair made of coarse sticks resembling that of a domestic pigeon, but larger in size, contained but one egg in an advanced state of incubation. It was placed on a live oak limb, near the end of the limb but not among thick twigs. As to identification there was no doubt as I was close enough to the bird to observe the cervical white half collar.

From personal recollection I can supply other details. The nest was built in a small oak tree on a steep hillside not over eight or ten feet from the ground and easily reached by stepping up into the tree. I had been in the habit of hunting pigeons in the fall and winter in the vicinity of Atascadero and Santa Margarita and though I used to visit Lopez Canyon every spring for a number of years never observed the birds to remain there in the spring except this one season. On this particular day I saw perhaps half a dozen pairs of the birds around different parts of the canyon which, in those days at least, was probably not visited more than once or twice a year by anybody. I saw one other nest located within a hundred yards or so of the one above described, but placed so far out on slender limbs above the head of the canyon that it was totally inaccessible.—NATHAN MORAN.

WILDCAT EATS BIRDS.

On March 10, 1919, I killed a female California wildcat (*Lynx eremicus californicus*) near Coulterville, California, which had been feeding entirely on song birds. The stomach contained the remains of six western robins.—DONALD D. MCLEAN.

A DEATH STRUGGLE BETWEEN BUCKS.

While hunting mountain lions on April 26, 1919, east of Squaw Creek in Shasta County, California, I came upon

some locked antlers (shown in the accompanying photograph, Fig. 54. The evidence was clear. There had been a fight between two bucks (owners of these antlers), occurring, probably, some time last November. In the heat of the battle their horns had become interlocked so tightly that they fell without disentangling them. The arena for this buck struggle covered an area of about twenty-five square feet in the corner of a meadow bordering on a small mountain lake. The bucks in their fury had trampled down the grass and vegetation and had even in places plowed up the ground with their hoofs. After a desperate struggle either the animals were overcome by exhaustion or famished from hunger and thirst. Winter came on, and coyotes and other predatory animals prowling around in search of something to devour made a delicious meal on their carcasses, leaving, however, the locked antlers in the condition in which I later found them.—JAY C. BRUCE.

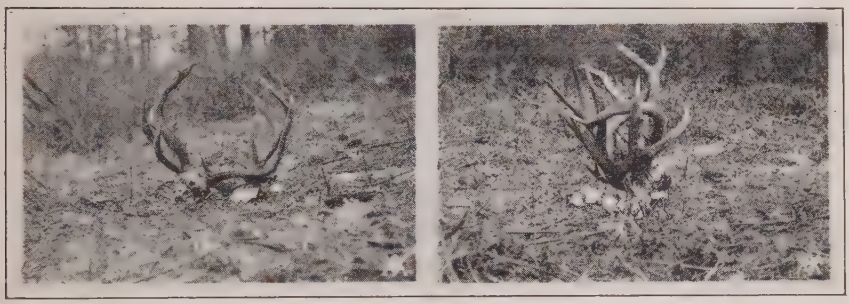

Fig. 54. Locked antlers of deer found on Squaw Creek, Shasta County, by Jay C. Bruce. The death of more than one large buck is due to the locking of the antlers when fighting.

REPORTS.

Canned, Cured and Manufactured Fishery Products of California for the Year 1918, Compiled by Department of Commercial Fisheries.

CANNED.

	San Diego, cases	San Pedro, cases	Northern California, cases	Total cases
Abalone—				
1-pound		300	1,425	1,725
Albacore—				
1-pound		17,392		17,392
½-pound		56,214		56,214
¼-pound		9,195		9,195
Anchovy—				
5-pound			1,522	1,522
4-pound			227	227
½-pound			450	450
Barracuda—				
½-pound	24			24
Bonito and skipjack—				
1-pound	765	2,012		2,777
½-pound	9,527	48,342		57,869
¼-pound	12,310	5,395		17,705
Herring—				
1-pound (oval)			58,330	58,330
½-pound			5,817	5,817
Mackerel—				
1-pound		3,450		3,450
½-pound		4,068		4,068
Sablefish—				
1-pound			25	25
Salmon—				
1-pound (tall)			8,395	8,395
1-pound (flat)			3,304	3,304
1-pound (oval)			197	197
½-pound (flat)			22,540	22,540
Sardines—				
1-pound (oval)	17,790	136,632	593,315	747,737
½-pound (oval)	174	3,788	13,244	17,206
1-pound (round)		138,879		138,879
½-pound (round)	1,101	228,139	945	229,240
¼-pound (round)		51,841		51,841
1-pound (square)		50,076		50,076
½-pound (square), tomato	19,568	70,850	3,716	94,134
½-pound (square), oil			4,249	4,249
¾-pound (square)			133	133
¼-pound (square)	67,785	78,756	3,997	150,538
Shad—				
1-pound			5,056	5,056
Shad roe—				
½-pound			2,213	2,213
Skipjack—				
½-pound	42			42
Tuna*—				
1-pound	5,788	33,825		29,613
½-pound	41,652	164,744		206,396
¼-pound	2,647	29,404		32,051
4½-pound		268		268
Turtle—				
1-pound	300	199		499
½-pound	100	29		129
Yellowtail—				
1-pound	8,328	2,824		11,152
½-pound	31,737	28,537		60,274
¼-pound	405			405

*Includes some albacore.

Canned, Cured and Manufactured Fishery Products of California for the Year 1918, Compiled by Department of Commercial Fisheries—Continued.

SALTED FISH.

	San Diego	San Pedro	Northern California	Totals
Anchovy—				
Barrels	----------	20	310	330
25-pound cans	----------	----------	2,600	2,600
5-pound cans	----------	----------	1,000	1,000
Barracuda—				
Barrels	450	5	----------	455
Black sea bass—				
Barrels	53	----------	----------	53
Bonito—				
Barrels	12	17	----------	29
Mackerel—				
Barrels	110	380	1,521	2,011
18-pound kit	----------	----------	6	6
Rock bass—				
Barrels	9	42	----------	51
Rock cod—				
Barrels	9	2	----------	11
Sablefish—				
Barrels	----------	----------	72	72
Salachini—				
100-pound tubs	----------	----------	5,955	5,955
65-pound tubs	----------	----------	10,899	10,899
50-pound tubs	----------	----------	12,329	12,329
Salmon—				
Casks (mild cured)	----------	----------	2,796	2,796
Sardines—				
Barrels	2	852	107	961
40-pound barrels	----------	----------	1,252	1,252
25-pound cans	----------	----------	1,200	1,200
18-pound kits	----------	----------	6	6
Sea bass—				
Barrels	29	----------	----------	29
Shad—				
Casks (mild cured)	----------	----------	287	287
Yellowfin—				
Barrels	----------	35	----------	35
Yellowtail—				
Barrels	425	76	----------	501

NOTE.—Casks contain 800 pounds net; barrels, 200 pounds net.

Canned, Cured and Manufactured Fishery Products of California for the Year 1918, Compiled by Department of Commercial Fisheries—Continued.

MISCELLANEOUS PACK AND GENERAL INFORMATION.

	San Diego	San Pedro	Northern California	Totals
Albacore—				
Smoked, pounds	----------	31,420	----------	31,420
Kingfish—				
Dried, pounds	----------	19,000	----------	19,000
Sardines—				
Dried, pounds	----------	37,000	----------	37,000
Scotch cured, pounds	----------	4,620	----------	4,620
Yellowtail—				
Smoked, pounds	----------	1,000	----------	1,000
Fertilizer, tons	----------	1,521	----------	1,521
Fish meal, tons	1,123	3,216	2,874	7,213
Fish oil, gallons	17,400	67,858	261,466	346,724
Number of plants	13	34	40	87
Number of employees	1,427	2,783	3,829	8,039
Value of plants	$1,316,000	$2,773,660	$1,569,330	$5,658,990

California Fishery Products for Year of 1918,

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Sutter, Tehama, Glenn, Colusa	Alameda, Contra Costa
Albacore							
Anchovy	100		11,300				
Barracuda							
Bonito							
Bocaccio		1,633	2,061				
Bluefish							
Chilipepper							
Carp		14 834	8,250	23,296	60,294	3,303	86.865
Catfish		90,210		14,571	52,745	4,488	42,150
Croakers							
Coalfish			19				
Cultus cod	1,848	32,413	8.424				
Dolphin							
Dogfish			78,070				8
Flounder	14,793		732	1,522			3,077
Hardhead					10,848	7,309	9,704
Halibut	30.346	61,096	1,140				
Hake			8				
Herring	7,311		3,190,086				1,500
Kingfish			10				
Mackerel							
Marlin							
Mullet							
Pike			1,285	494	1,894	730	8,790
Pompano			3				
Perch	32,039	258	66,183				105
Rock bass							
Rockfish	57,408	6,500	716				
Sole	171		78				
Salmon	1,234,653	1,097,771	172,660	2,305,800	565,834	41,791	2,957,492
Smelt	13,209		24,012				316
Shad (roe)				194,549	35,108		673,237
Sea bass (white)			10,921				
Shad (buck)				159,921	13,990		241,015
Sea bass (black)							
Sanddab							
Suckers					6,719	190	358
Striped bass			22,773	353.100	113.578	5,066	751 830
Shad			1,639	224,773	104,813	2,069	671,804
Surf fish							
Stingaree			151,500				
Sturgeon							
Sardine	908	240	451				
Skipjack							
Skate							
Sheepshead							
Sculpin							
Splittail					3,139	3,726	1,115
Sea trout							
Swordfish							
Tom cod							
Trout (farm)							
Trout (steelhead)	21,819						
Tuna							
Turbot			3,087				
Whitebait		100	9.297				
Yellowtail							
Miscellaneous	2,000				3,640	3,251	41
Total fish	1,416 605	1,3 5,025	3,765,305	3,278,026	972,602	71,923	5,449,497
Crustaceans—							
Crab (dozen)	4,128						13
Spiny lobster							
Shrimp							
Ecrevisse							
Mollusks—							
Squid			85				
Cuttlefish		100	10				
Clam (Pismo)							
Clam (cockle)			23.652				
Clam (softshell)	1.085	13.105	125.575				173 278
Clam (mixed)	20,211	1,867	72.842				10,780
Oyster, eastern (shell), number			885.811				
Oyster, native, pounds			39,279				
Abalones	1,935	405					
Sea snails							
Mussels	760		672				4,297
Reptiles—							
Terrapin (dozen)			25				
Sea turtles							

Compiled by Department of Commercial Fisheries.

San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Totals	Mexico
	39	5,084	918	6,434,770	230	822,854		7,263,895	1,527
257,170		540,323		49,392		9,566		867,851	310
17,160	66,899	37,572	41,185	1,988,598	9,343	1,724,934		3,885,691	951,593
	33,541	6,607	13,046	978,120	363	1,233,087		2,264,164	176,667
49,351	106,081	1,083,074						1,242,170	
	558	69,340		185				70,083	
209,172	89,537	54,622						353,331	
36,073				79,859				312,774	
712								204,876	
				56,031		11,095		67,126	
478,844	3,593	11,530		4,221	730			498,937	
446,796	123,853	300,432		1,613	457			915,836	
				741				741	
274,099	500	11,359		14,731		21,711		400,478	2,615
716,080	47,178	27,243		6,679	240	1,291		818,835	
								27,861	
40,990	8,619	25,544	309,378	1,145,734	13,974	1,201,166		2,837,987	1,915,704
143,678	47,313	2,019	64	17,094		8,496		218,672	5,360
4,732,883	5,900							7,938,280	
62,726	83,342	154,128	734	650,281	349	23,525		975,095	
	973	1,489,163	4,497	2,346,048	6,242	158,983		4,005,906	70,178
				2,275				2,275	
				30,267			59,390	89,657	1,745
172								13,365	
1,786	2,752	6,699	44	12,876		100		24,260	
52,810	10,180	6,551	1,616	26,771	374	1,280		198,167	365
			6,393	535,375	3,644	231,233		776,645	7,219
1,340,106	644,450	1,109,737	123,395	1,575,558	25,512	1,398,043		6,281,425	12,912
4,696,906	1,893,705	293,529	85,749	53,110	166	4,353		7,027,767	
1,756,134	209,923	2,682,953		1,065				13,026,076	
2 3,900	32,550	164,388	30,747	196,809	76,910	46,082		788,923	8,061
								902,894	
40,413	171,885	59,137	64,648	1,015,478	1,054	88,942		1,452,478	154,853
								414,926	
		248	6,184	97,432	2,969	103,599		210,432	38,363
1,383,057	308,403	41,154		21,970	25			1,751,609	
								7,267	
161,353	47	94						1,407,841	
60,717								1,065,815	
				4,888				4,888	
				300				151,800	
892,026	559,265	64,915,002	42	78,077,612		13,207,265		157,652,811	
	728	155		3,019,686	133	3,145		3,023,847	
232,801	2,090	4,078	425	6,809	28			246,231	
			45	8,605		13,838		22,488	490
165		2		28,156		81		28,404	
								7,980	
				4,902	941	346		6,189	
				17,862		580		18,442	
8,756	55			39,566	159			48,536	
1,657	1,781					392		3,830	
								21,819	
	315	1,580	1,174	5,807,961		429,941		6,240,971	
			525	52				3,664	
108,053		81	18,326					135,857	
21,520	124,052	137,261	20,782	5,926,021	1,060	5,427,563		11,658,259	139,946
93,366	1,001	36,863	14,928	139,409	3,175	31,940		329,614	264,163
18,518,432	4,581,108	73,276,952	744,845	110,424,912	148,078	26,205,431	59,390	250,218,041	3,752,071
								67,458	
62,079	707	531						195,750	735,077
			29,979	120,796	2,611	42,364		722,178	
722,178									
1,970	850	301,007		43,376		14,426		361,714	
14,583	4,406	13,268		372				32,739	
	517		665,167					665,684	
			160	21,121				44,933	
								313,043	
344	252	340	1,359	21,089				129,084	
5,302,210								6,188,021	
								39,279	
		365,986	183,863	50,730				602,919	
				1,461				1,461	
5,334	4,270	600	9,954	21,251	600	580		48,319	835
								25	
						18,135		18,135	12,496

CALIFORNIA FISHERY PRODUCTS.

Compiled by Department of Commercial Fisheries, January, February, March, 1919.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Glenn, Colusa, Sutter, Butte	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexico
Albacore												348		30		378	13,647
Anchovy										9,120		114,500		100		123,720	
Barracuda								13			35,575	37,653		101,498		174,739	434,451
Bonito											50	75,653		3,853		79,556	91,542
Bocaccio								8,056	38,213	498,030						544,299	
Bluefish								9,540		15,172						24,712	
Chilipepper										13,444						13,444	
Carp		3,660		2,332	62,428	80	40,956	335				50				109,841	
Catfish		23,313		3,569	20,488		5,174									52,544	
Coalfish								75			18	132				225	
Cultus cod	300							117,193	18,177	50,246		26				185,942	
Dogfish				11				74,940	235	100	2,530	18,994		55,162		151,972	
Flounder	10,095		454				2,233	64,897	21,203			6,092				104,974	
Halibut	43							16,604	2,652	927	64,751	597,768	12,048	105,622		800,415	175,004
Hardhead					24,744		1,416									26,160	
Hake								483	1,156			9,452		770		11,861	755
Herring	6,419		3,714,638				59,822	470,891	350							4,252,170	
Kingfish			32					21,743	10,087	5,553	961	254,802	43	6,920		300,141	55
Mackerel									29	216,018	164	38,795	33	6,556		261,595	2,640
Mullet															2,359	2,359	
Pike				433	1,410	10	2,532									4,385	
Pompano			2					4	200	206		44,836	32	66		45,346	
Perch	15,824		16,767				46	5,918	9,608	2,608		2,542		12		53,325	
Rock bass												16,053	85	25,478		41,616	6,905
Rockfish	1,106							576,596	150,768	151,935	30,305	630,140	2,716	312,295		1,855,861	39,470
Sole								1,056,534	116,820	13,825	43,626	46,034		4,134		1,280,973	
Salmon	263			40,009	15,208	71,695	137,553	1,646	1,687	216,430						484,491	
Smelt	6,913		11,045				245	71,798	2,612	1,307	1,087	43,266	23,882	23,720		185,875	1,375
Sea bass (white)			719					265	165	135	681	57,357	56	5,933		65,311	3,425
Sea bass (black)												10,389	791	9,631		20,811	815
Sanddab								139,207	11,177	158		2,585		651		153,778	
Suckers					3,276											3,276	
Striped bass			810	62,347	10,702		153,898	20,923								248,680	
Shad, roe				837	81		12,301									13,219	

Shad				11,928	4,221		15,048	821								32,018	
Shad, buck				615			18,901									19,516	
Splittail					12,567		10,490									23,057	
Sardine								11,745	385,840	16,778,984		29,205,399		4,780,739		51,162,707	
Skate								112,659	908		150	7,319	475			121,511	
Stingaree								4,000						824		4,824	
Sculpin												3,915		104		4,019	
Skipjack												210				210	
Sea trout												1,655	15	862		2,532	42
Sheepshead												5,298		8,342		13,640	
Tom cod								8,018								8,018	
Trout (lake)																	
Trout (steelhead)																90	
Turbot				90								789		123		912	
Tuna																2,014	
Whitebait			367					1,647				178,889	189	39,376		218,454	11,253
Yellowtail																162,966	10,804
Miscellaneous	356							21,413	505	1,370	12,476	124,035	1,472	1,339			
Total fish	41,319	26,973	3,744,974	122,081	155,125	71,785	460,615	2,817,964	772,392	17,975,568	192,374	31,534,976	41,837	5,494,140	2,359	63,454,482	792,183
Crustaceans—																	
Crab (dozen)	721							8,196	285	79						9,281	
Spiny lobster											5,093	43,786	3,912	7,466		60,257	193,580
Shrimp								137,886								137,886	
Ecrevisse																	
Mollusks—																	
Squid												1,119		445		1,564	
Cuttlefish			36					2,292	608	4,878		72				7,886	
Clam (Pismo)									75		110,126					110,201	
Clam (cockle)			3,874								560	2,649				7,083	
Clam (softshell)		3,307	13,204				62,472									78,983	
Clam (mixed)	9,760	626	10,086								2,228	218				22,918	
*Oyster (shell), No.			359,286					1,900,700								2,259,986	
Oyster (native), No.			14,856													14,856	
Abalones									225	26,220	39,891					66,336	
Mussels	380						1,535		940	925	6,313	1,266		100		11,459	
Sea snails												653				653	
Reptiles—																	
Terrapin (dozen)		62														62	

*Eastern.

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